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THE NEWTON STEEL COMPANY
YOUNGSTOWN, OHIO







To our workmen, who have given
freely of their abilities and their
labors toward the perfection
of Newsteel Sheets, this
volume is dedicated.



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NEWSTEEL SHEETS

*A treatise on their
manufacture,
application and
uses, with which
is combined many
helpful tables and
other data of vital
interest to
Manufacturers*

THE NEWTON STEEL COMPANY
YOUNGSTOWN, OHIO

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Newsteel Workmen



Amid the fiery glow of grim visaged furnaces and the thunderous hum of hot rolls and cold rolls. before the jump and snap of cutting shears. or beside malodorous pickling baths. Newsteel workmen perform their tasks as part of an industry that carries on the progress of a tremendous force—the fashioning of steel to potential usefulness.

No forced pride could give such craftsmanship; no shallow loyalty could offer the measure of their sincerity and endeavor. No false standards could urge these men to the gruelling and breaking toil of giving to industry those steel sheets which, in their very appearance, proclaim a finished work by expert hands.

To these men comes the responsibility; to them must go the credit. The success we enjoy, the reputation we hold, are due—in no small part—to the men whose knowledge and experience have made possible the Newsteel Sheet.





Newsteel Quality

What a multitude of burdens steel—good steel—has lifted from the shoulders of mankind! What a host of things are made from it! What possibilities loom ahead, tomorrow, for it!

Yet, with the ever-increasing circle of uses and discoveries, there appears this caution—a *product can be no better than the materials from which it is made*. And, all the mechanical skill, and ability, and ingenuity of this efficient era cannot overcome the woeful handicap of inferior raw materials.

Of what avail is a product, no matter how expertly constructed, which ultimately fails through the use of a material less worthy than Newsteel Sheets! For failure is quickly recognized and cast aside.

Newsteel Sheets—good steel—are made for those products that demand the best and for which there is not, and never can be, a question of compromise or substitute.





Newsteel Service



The continuous operation of any manufacturing plant is, of course, primarily dependent upon the demand for its products. But there is a vital part played by the prompt and constant delivery of raw materials.

No matter how great may be demand, or facilities and capacity for production, manufacturers invariably encounter a difficult problem when their supply of working materials is delayed or temporarily suspended. Production falters and falls away gradually, or halts abruptly. And how often disaster is averted only by turning to a fortunately unexpected or highly expensive source of supply!

In each contract for Newsteel Sheets there is an assumed duty that embraces infinitely more than the actual production of specified tonnage. It is a deep and natural urge for rendering a helpful assistance, prompted by an intimate knowledge and understanding of the fabricating requirements in working with steel.

It is the definite assurance of uninterrupted production—the removal of that apprehension which, at times, hovers over the manufacturers who cannot physically or economically regulate output to meet the variance or tardiness of their raw material supply.





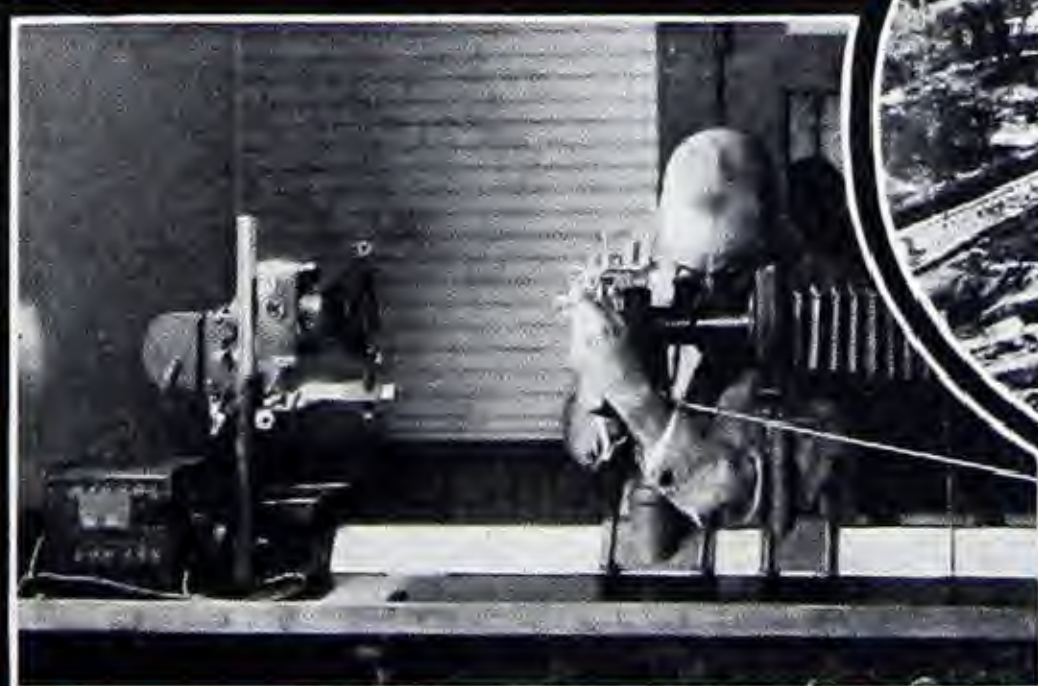
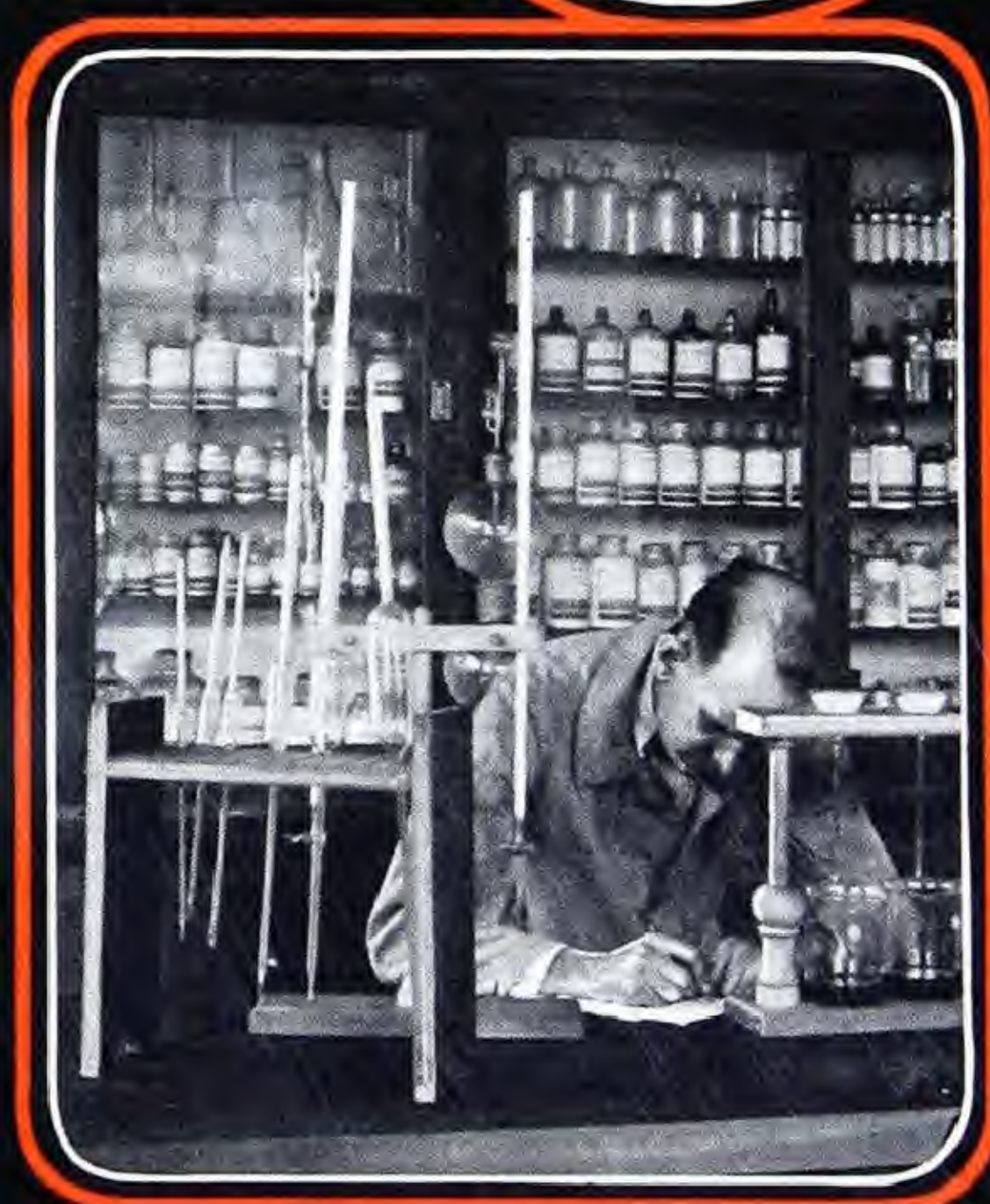
Newsteel Co-operation

The methods and manners of manufacturing steel products differ. Some are formed quickly, and often easily—others necessitate exacting and complicated fabrication. Each, however, encounters its own particular difficulties.

To lessen these problems, and eliminate them entirely where possible, the Newton Steel Company maintains an experimental laboratory equipped not only to assure the perfect adaptation of Newsteel Sheets, but also to determine such improvements that will more than adequately meet the severe stress of deep draws, sharp bends, and curves of the various operations through which steel sheets must proceed successfully.

There is no idle or passive tampering in this laboratory. It was instituted to wage a conquest—the true objective of which is to attain a tangible helpfulness for the manufacturers upon whose products rest their reputation for honest merchandise.

It gropes for no revolution in the use of steel sheets—but seeks the reduction of human energy in labor, an added precision in automatic processes, and to safeguard the interests of any and all manufacturers who aspire to hold their present leadership and build for a future that is governed only by the limits of imagination.





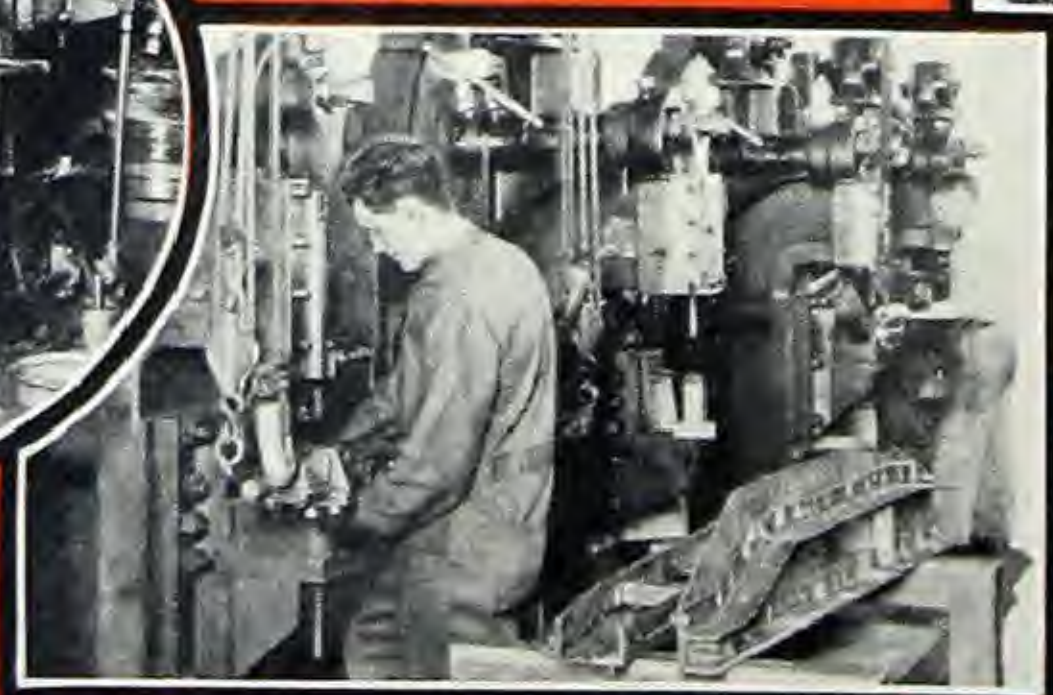
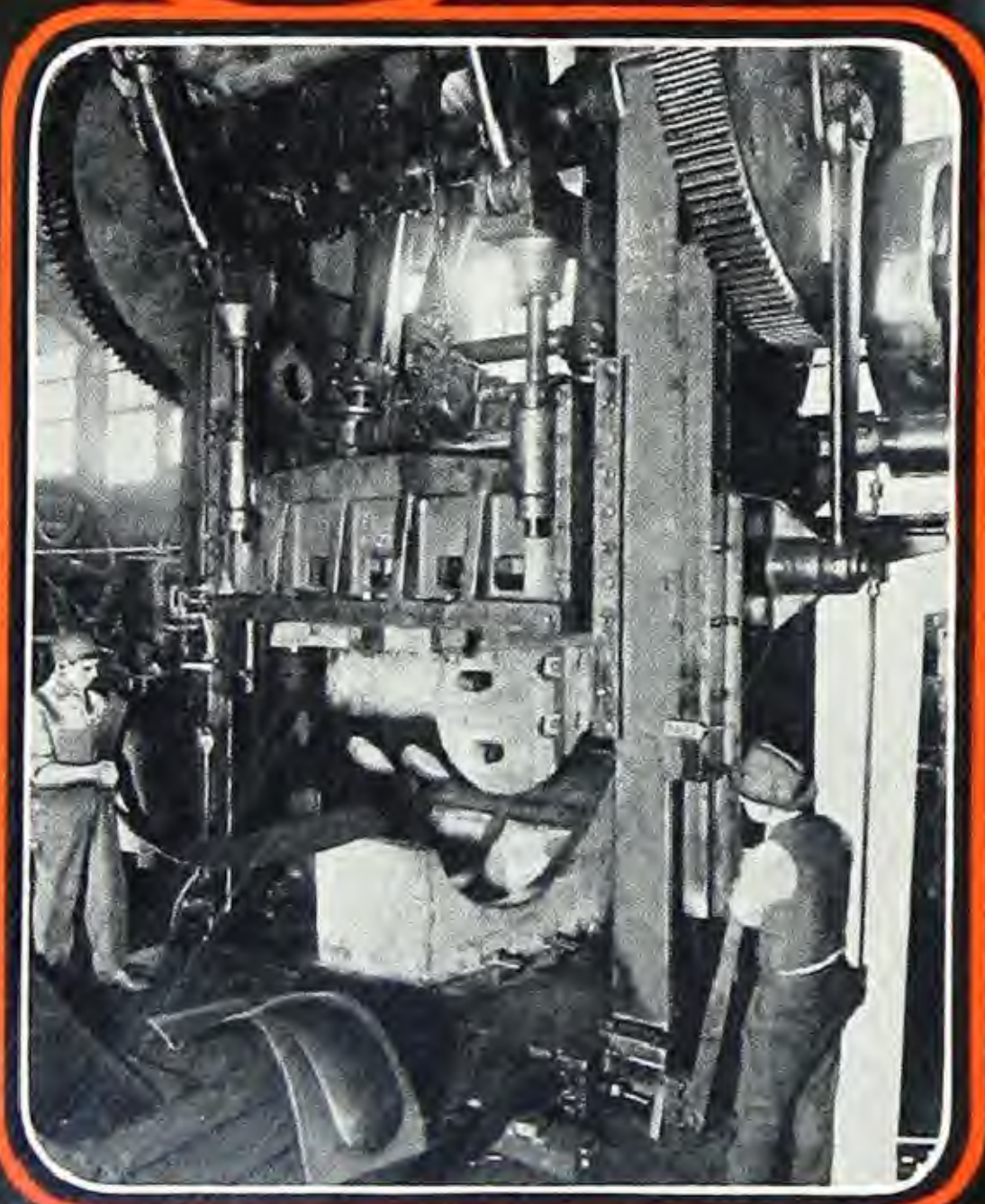
Newsteel Full Finished Sheets

The Full Finished Sheet is the Newsteel master product. From the careful selection of raw material to the last close inspection and final approval, this sheet passes through a series of definitely exacting operations under the watchful guidance of experienced steel makers of established ability. At no point in the process to completion is any detail of perfect formation omitted or overlooked.

In the exceedingly fine and uniformly smooth surface is found the great worth of the Newsteel Full Finished Sheet. Minute surface defects and slight irregularities are totally eliminated by the particular methods in the various treatments of annealing and pickling, stretcher leveling, and numerous loose rollings.

The last processes through which this sheet is passed, conclusively assure a surface that is a precise essential in the manufacturing of electrical appliances, automobile hoods and fenders, cash registers, household furniture, safes, etc.

A Full Finished Sheet which does not attain a degree of excellence unmarred in the least by blemish or weakness, is quickly discarded. And these rigid laboratory standards have fixed firmly the indispensable requisites which must be embodied in the composition of such sheets.





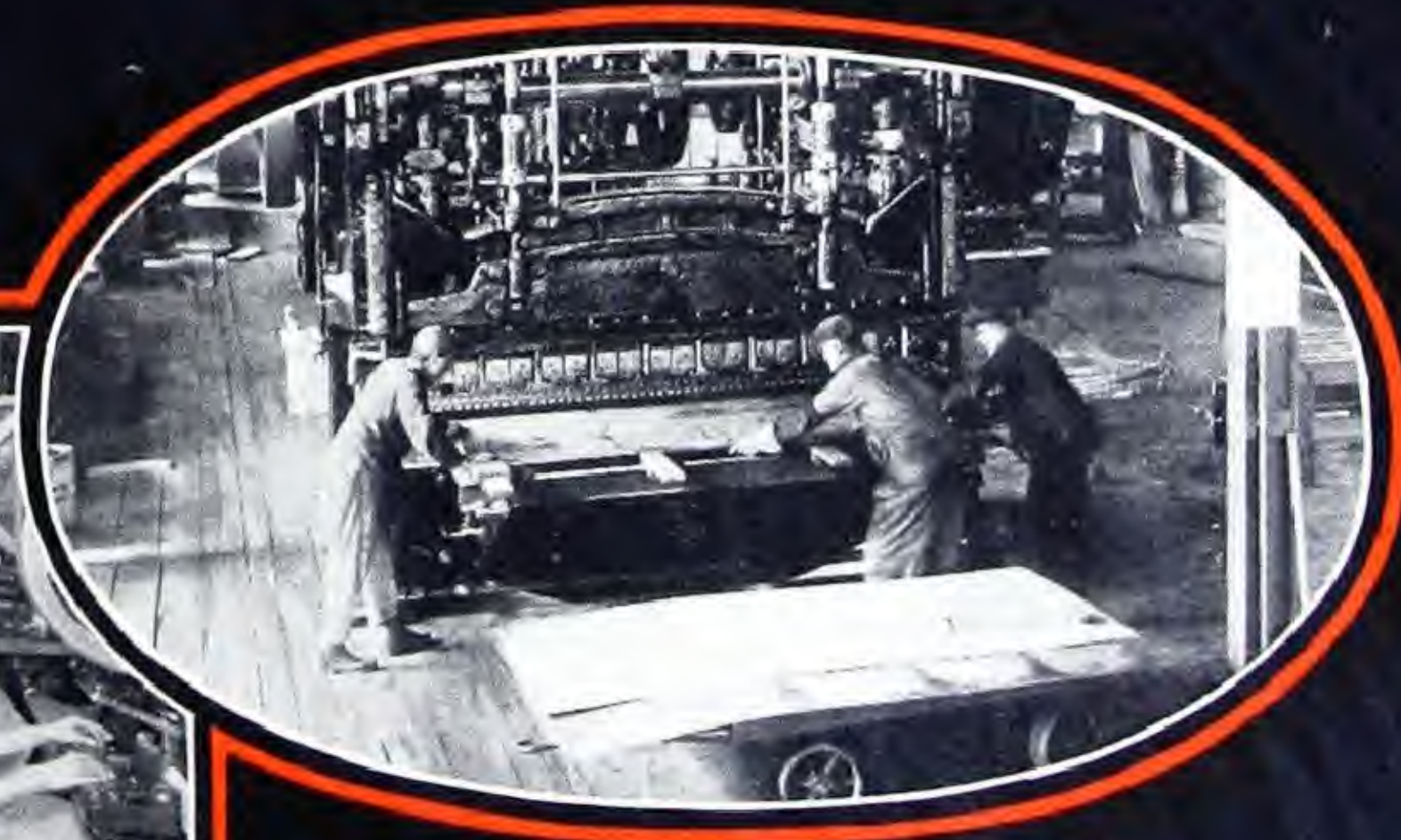
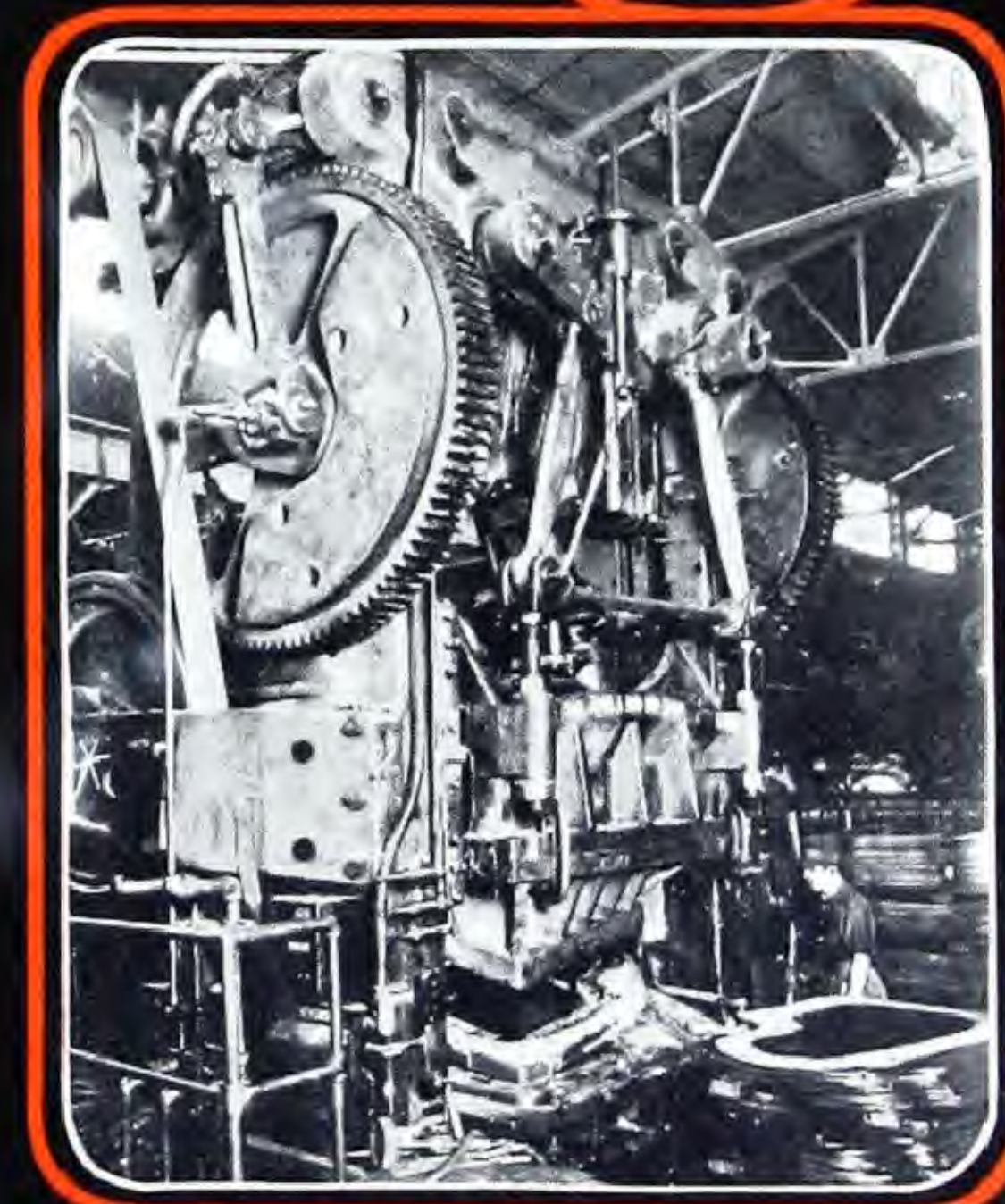
Newsteel Special Annealed Sheets

The Newsteel Sheet is in its softest and toughest state when annealed. But the wide diversity of uses to which the Newsteel Special Annealed Sheet is adapted causes a variance in the handling, finish, and standards of annealing.

For instance, to properly temper and render workable many of the sheets used by the automotive industry, a special process—often an individual series of operations which call for the closest adherence to the highest standards of sheet steel making—is essential. Toughening the sheet to take the extra deep and exacting draws, bends, and angles, necessitate a knowledge of sheet steel making by workmen of long experience.

The factor of progressing the sheets through the successive temperatures of heating and cooling, governs entirely the condition of the small granular construction of the metal. Every precaution is taken to guard against unexpected manufacturing delays which might interfere with the timing of the work at any stage. Temperatures are automatically recorded and the length of annealing time is carefully regulated and supervised.

All Newsteel Special Annealed Sheets are submitted to the Olsen, Ericson, and Rockwell tests, and microphotographs are made and studied as a final assurance of perfect annealing.





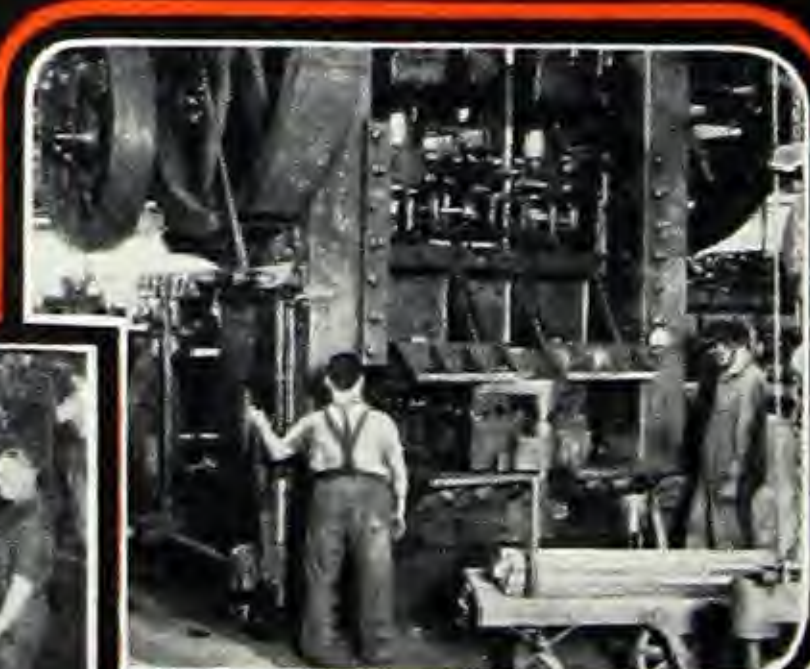
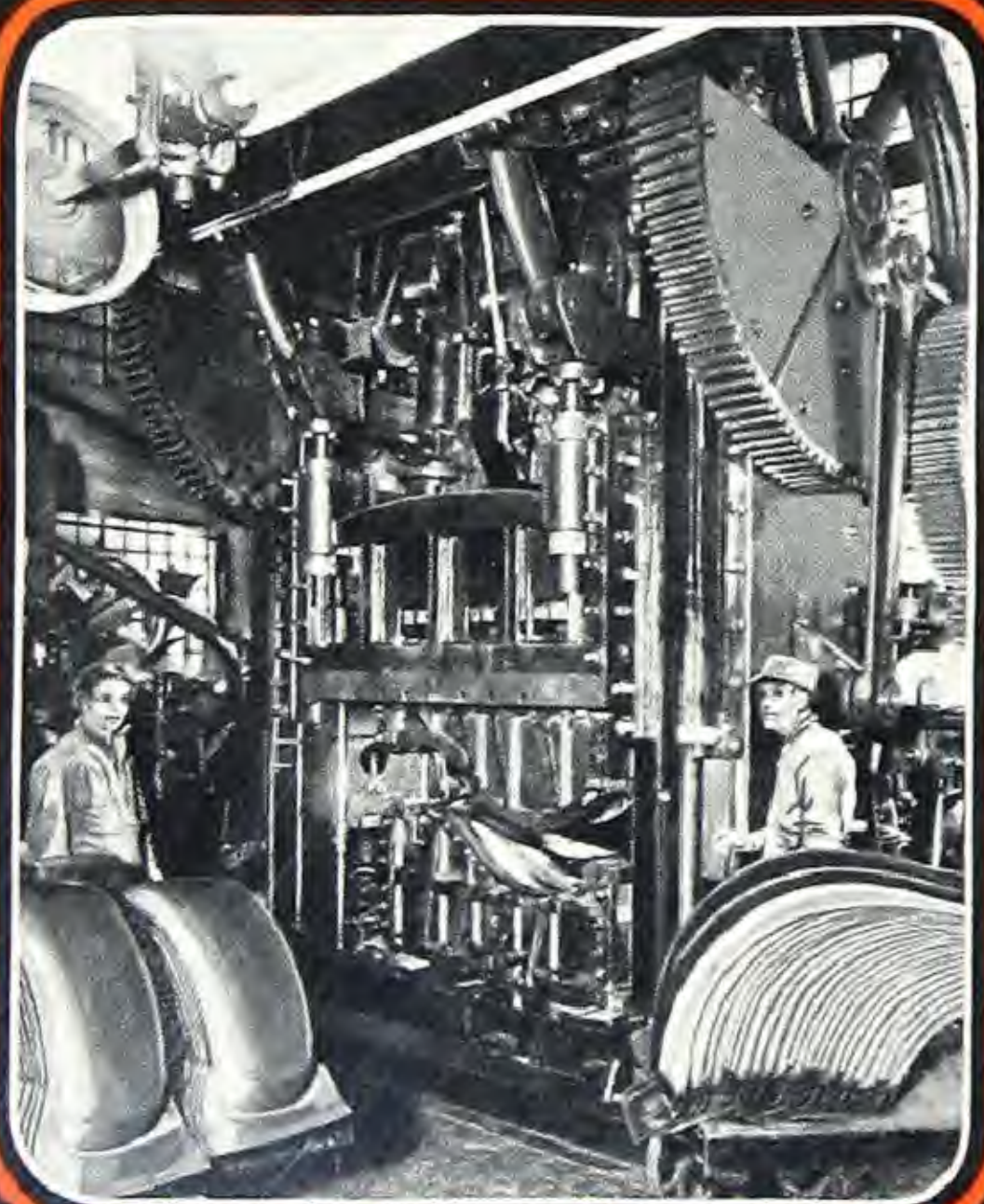
Newsteel Pickled Sheets

Much of the perfection of Newsteel Sheets is attained by the especially effective methods used in the pickling processes.

Each sheet is dispatched through the baths on a definitely timed schedule of immersion in acid and in rinsing water. A strict supervision is exercised continuously to make certain the exact acid measures and the length of agitating the sheets in the baths. For too much acid causes blistering, and too little fails to remove all of the small particles of scale, dirt, and grease. Of no small importance, too, is the operation of freeing the sheet from surplus acid by thorough rinsings.

All acid solutions are separately checked and analyzed by laboratory tests. A detailed report is made and a permanent record is kept of the specific action and final outcome of the solutions used for different sheets.

Because surface impurities are often the cause of failures, pickling is generally recognized as an operation which either makes or breaks a steel sheet. It is fitting, then, that Newsteel Sheets receive not only the common prescribed operations known in pickling, but intensified processes vitally necessary to produce steel sheets indicative of Newsteel quality.





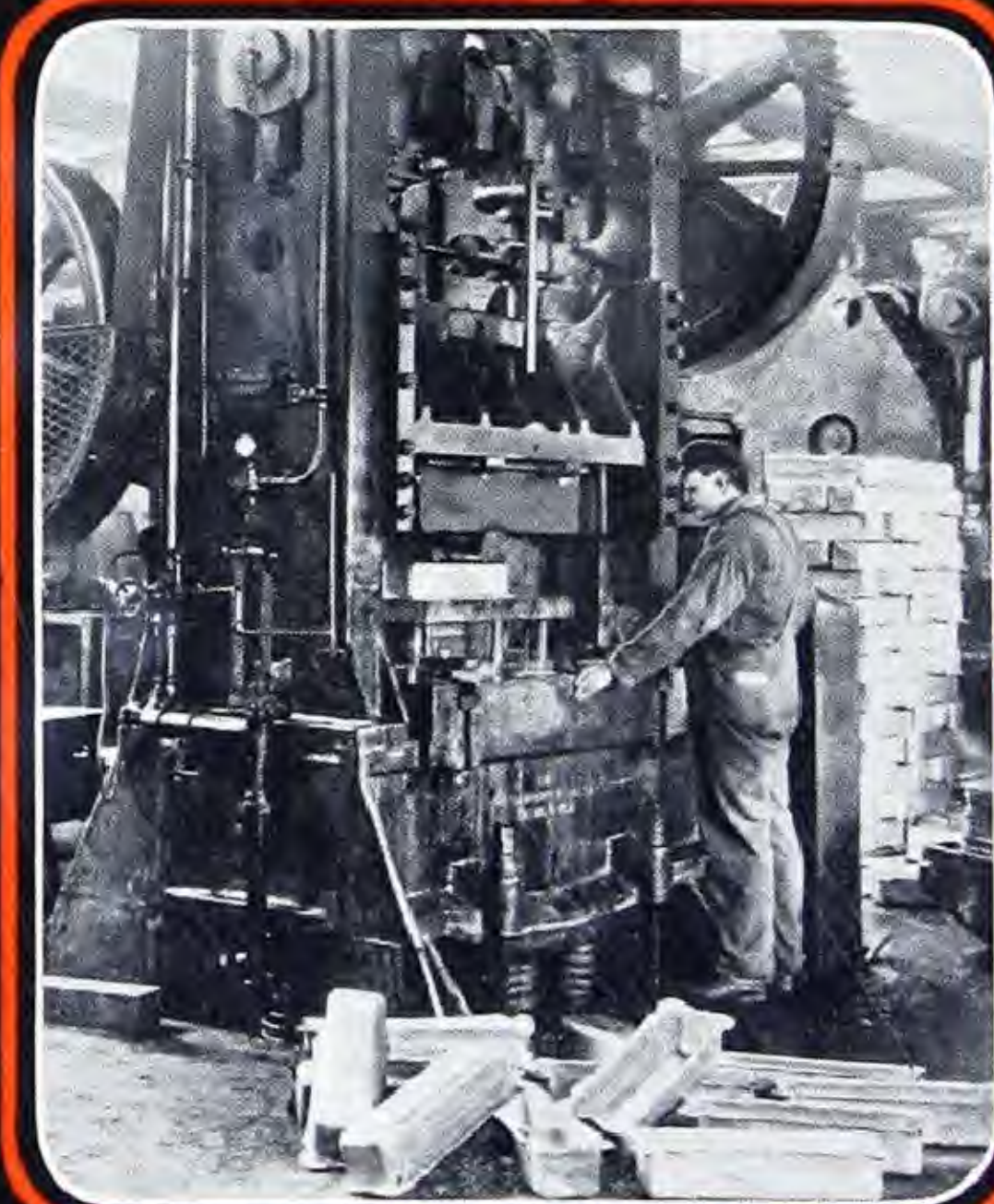
Newsteel Special Sheets

Special Newsteel Sheets are made for the manufacturers of products which require a material of individual and exceptional qualities.

These sheets, according to their varying specifications, may be of sizes not standard in sheet steel making; they may necessitate special treatment in heating, unusual handling in the hot and cold rolls, a particular process of annealing, or even a special basic steel. For upon the behavior of these sheets in the fashioning dies—intricate punchings and cuttings, uncommon stampings and shapings, sharp angles—depend the satisfactory results in the finished product.

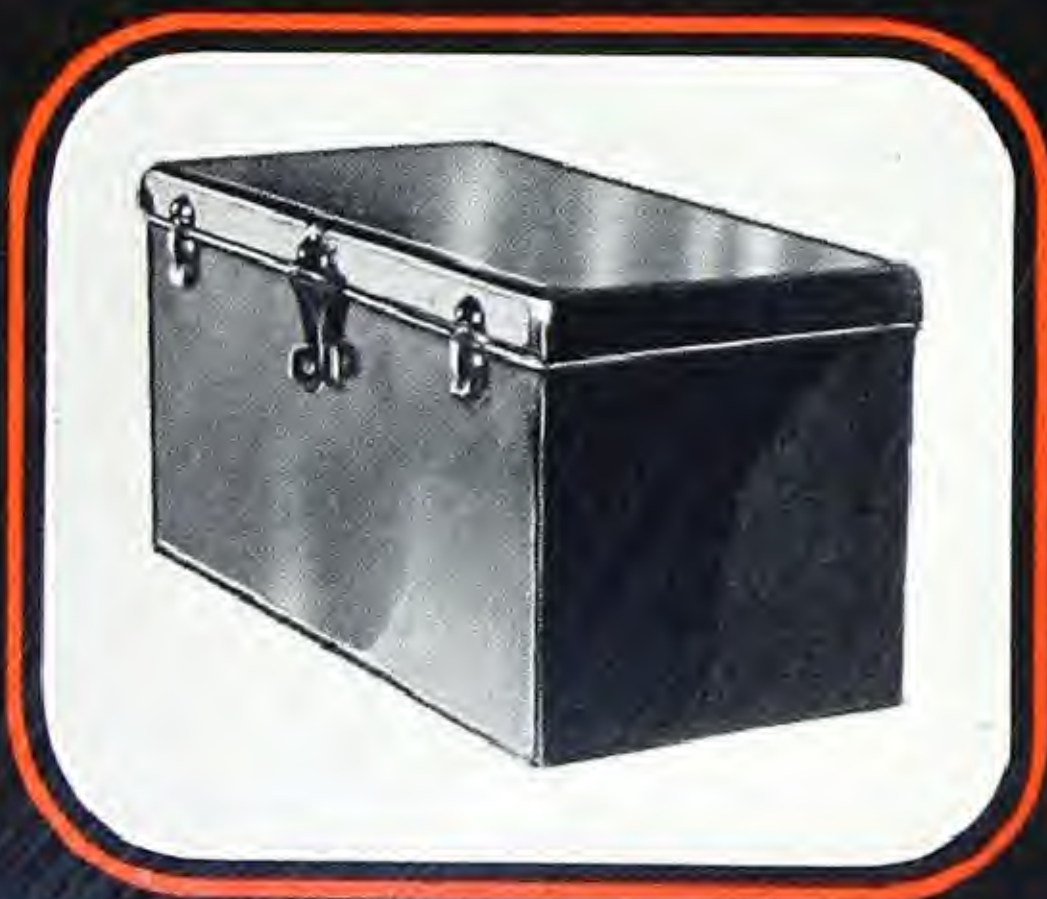
When an order for such sheets is placed, a Newton representative—expert in his work—is assigned to study the particular requirements, and analyze the construction of the dies and the operations through which the sheets must successfully pass. From his report is ascertained definite information that is indispensable in manufacturing the sheets to conform exactly and adequately to stated needs.

But regardless of how exacting may be the specifications, Newsteel Special Sheets are made in conformity, unsurpassed in strength, adaptability, and true fineness.





Newsteel Sheets



There is a joy—a certain eluding fascination—for the men whose task it is to make steel sheets for the building of automobiles! Who can define the incentive for true craftsmanship that accompanies the expert labor of the men who produce the raw materials which go into this ingenious invention?

It may be that they can see ahead the new paths opening for some proud owner; that they sense the happy pilgrimages the automobile will make; or the thrill of travel it will give to many journeys. It is certain they realize the great responsibility placed in Newsteel Sheets by their use in the construction of the automobile; and, too, in the building of cab, truck, and trailer—those busy carriers in the endless, swift moving traffic of trade and commerce today.

They know the work of their hands must stand a test of strength and durability never before demanded of steel.

Consider the severe operations through which sheet steel must pass. Cowls, crown fenders, and radiator casings are subjected to extra deep draws in order to form them from a single sheet. An improperly rolled and treated





for Automobiles

sheet will crack at the sharp strain or weaken so that it becomes, sooner or later, a defect in the finished product. Bodies, hoods, flat fenders, doors, aprons, and splash guards are subjected to draws that cannot be successfully withstood by an inferior steel sheet.

And the smaller parts must take bends, stampings, punchings, and curves. Disc wheels, fans, horns, trimmings—all must be made from a material that lends itself to accurate and rigid shapes and yet retains its full strength. For in service these, and the many other parts made from sheet steel, must absorb without failure the shocks and stresses that soon break down a less durable construction.

To fashion a bar of steel into a perfect automobile sheet, requires more than the mechanics of sheet making. That which is added to the Newsteel process constitutes an interest that extends even farther than the actual fabrication of automobile parts—it reaches to the service that these parts must render.

Such an interest in the finished product made of Newsteel Sheets, cannot help but impart to them a quality certainly lacking in a metal which is just steel—and no more!





Newsteel Sheets for



It's not so long ago that the four-poster reigned. It's easy to remember the heavy high-boy, too; and the cumbersome chest of drawers which stood in the corner.

They were signs of the times, though. They matched very well the fashions of the day when carriage and shay took the folks to barn dance and bazaar—when nine o'clock was considered late.

Those were days when the durability of most furniture was fixed by the weight of it. A dresser, for instance, whose end could barely be lifted from the floor was adjudged solid and sturdy. Later, fewer braces and thinner wood were used; and the deep floral carvings and lion head decorations disappeared.

Standards are ever changing. The hand of betterment waves the old aside for the new. And sheet steel is rapidly taking the place of wood in the making of furniture for the home.

For sheet steel—good sheet steel—embraces all of the desirable features of wood in addition to giving the durability of the strongest known metal.

In Newsteel Sheets there is a strength that cannot be lessened by the severe strains of





Metal Furniture in the Home

short curves and sharp angles, stampings, or the fine punchings which are necessary attractively to shape bedsteads, chiffirobes, and vanity dressers. Tables, chairs, and chests—ordinarily of simple design—can be formed easily and exactly because Newsteel Sheets, while conducive to solid and substantial construction, possess a ductility that permits of quick fabrication.

The dependable uniformity of the fine and even surfaces of Newsteel Sheets takes and holds finishes—plain and composite—in such a manner that the mere rubbing with a damp cloth renews the lustre of varnish or enamel. And in their perfect finish lies much of the worth of these sheets from which are made, for modern homes, decorative furnishings of great strength, light and convenient weight, and homey desirability.

The buyers of steel furniture want more than goods of mere metal. They want serviceable household pieces that are smartly indicative of the pleasing grace and charm that bespeaks the comfort, the utility, the individuality of the places where they live.

For them, Newsteel Sheets are made.





Newsteel Sheets for



The twentieth century marked the passing of the imposing walnut secretary—without which, in those eventful days, no office was quite complete. It usually stood between two windows, right under the extra gas jet, and constituted a combination writing desk, book rack, filing cabinet, and safe. The total number of its functions, though, depended upon the profession of the owner. It was always cluttered with papers—for at times it was the only furniture, aside from a squeaking chair or two.

Business men began spending more and more of their time in offices. Conferences became a vogue—and are yet. The furnishings of offices assumed a new and greater importance. Efficiency crept in and soon developed into a habit. Walnut secretaries began appearing in antique shops.

The replacements—pieces of office furniture for a single purpose—came quickly after their first introduction. They were made of hard woods, and required the same care as furniture in the home. The drawers would warp and defy all efforts to move them, in or out. The pieces were heavy. And how often they had to be moved! Other grievances came to light at short intervals.

Then sheet steel—good sheet steel—made





Metal Furniture in Industry

its contribution to furniture in industry. It offered the strongest known material—one unmatched in durability and lightness.

But sheet steel used for this purpose cannot be ordinary. For it must retain all of its original strength and durability after much bending, forming, and fashioning. Beside the larger pieces, channel shape strips, angle posts, clips, and other details must be exactly fabricated from a sheet steel of uniform quality.

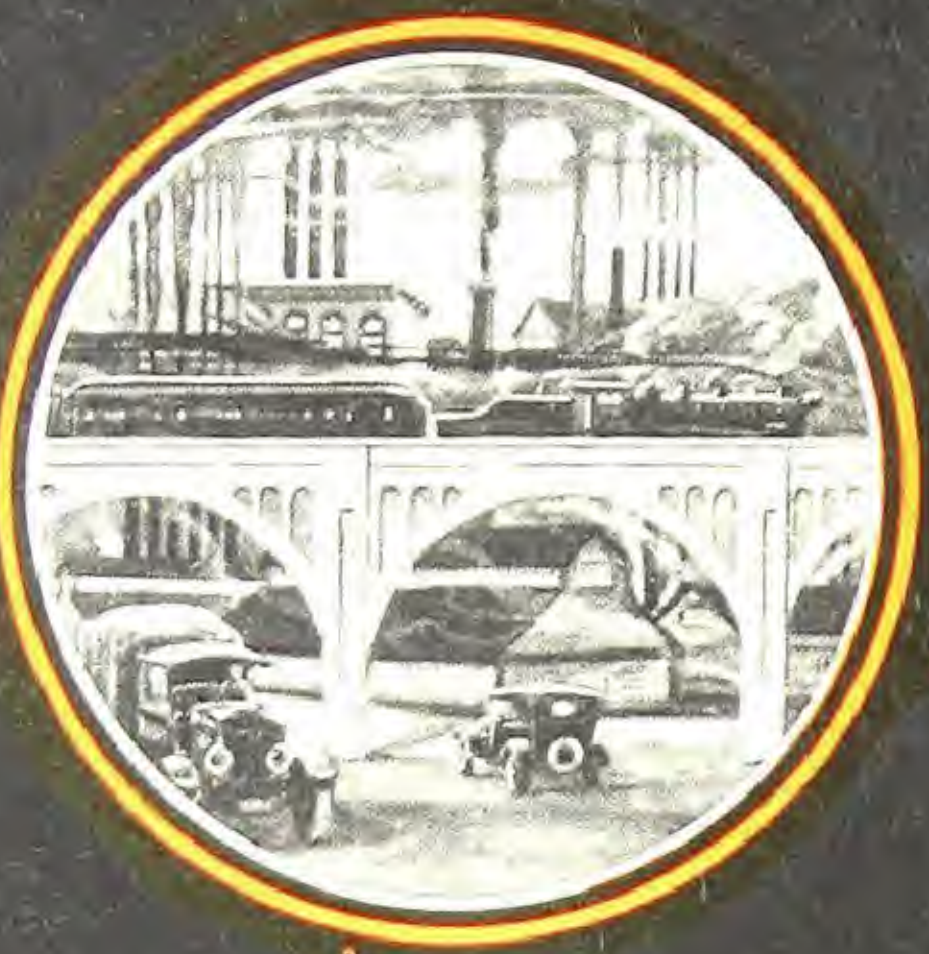
A partial list of office furniture and equipment clearly shows the wide range of uses and includes flat and roll-top desks, filing and book cabinets, lockers, safes, tables, chairs, waste baskets, office partitions, etc.

And Newsteel Sheets—good steel sheets—not only provide just such a material necessary in the exacting fabricating processes, but are distinctly outstanding in their ability to take without effect the wear and general abuse given to office furniture. Varnishes and enamels can be applied to these sheets with a sure knowledge of their long retention.

For metal office furniture and equipment, which depends in a measure on an attractive appearance to truly indicate sound construction and value, Newsteel Sheets have gained a place of preference that cannot be usurped.



Newsteel



MILLS AND FACTORIES

AIR COMPRESSOR PARTS	FERTILIZER PANS	TANKS
BLOWERS AND PARTS	GAS PRODUCER PARTS	TELEPHONES AND PARTS
BOILERS	GAUGES	TOOLS FOR EVERY PURPOSE
CENTRIFUGALS	HARDENING TRAYS	TURBINE AND IMPELLER
CHUTES	HUMIDIFIERS	BLADES
CONVEYORS	OIL FUEL APPARATUS	VARNISH KETTLES
DIAPHRAGMS	OIL STILL	LADLES, ETC.
DRYERS	PANS	VATS
EJECTORS	PULLEYS	VENTILATORS
ELECTRICAL APPLIANCES	PUMPS	WASHERS
ELECTRICAL MACHINERY	ROOFING AND SIDING	WATER METER PARTS
ELEVATOR PARTS	SCALES	WEIGHING MACHINES
ENAMELING TRAYS	SIGNAL APPARATUS	AND PARTS
FANS	STEAM HEATING EQUIPT.	
	STILLS	



IN OFFICE AND STORE

ADDING MACHINES	ELEVATORS	POTS
ADDRESSING MACHINES	ENVELOPE MACHINES	RAILINGS
ASH TRAYS	FANS	REFUSE CANS
BANK FIXTURES	FILE CABINETS	RESTAURANT EQUIPMENT
CASH REGISTERS	FURNITURE	SAFE DEPOSIT BOXES
CHECK PROTECTORS	GRIDS	SAFES
CIGARETTE HOLDERS,	HEATING TABLES	SCALES
CASES, ETC.	KETTLES	SERVING WAGONS
COLD STORAGE EQUIPT.	KICK PLATES	SODA FOUNTAIN EQUIPT.
COUNTERS	METAL FURNITURE	TELEPHONES
CUSPIDORS	ORNAMENTAL WORK	TELEPHONE BRACKETS
DESKS	OVENS	TYPEWRITERS & EQUIPT.
DESK SETS	PANS	VAULTS
DISH WASHERS	PLUMBING AND FIXTURES	URNS



AUTOMOTIVE INDUSTRY

ACCESSORIES	HEAD LIGHTS	PUMPS
BODIES	HOODS	RADIATORS
BUSSES	HORNS	SPOT LIGHTS
DASHBOARDS	HUB CAPS	STARTING DEVICES
DISC WHEELS	INDICATORS	STEERING GEARS
DROP PANS	LAMPS	TANKS
EXHAUSTS	LICENSES	TRIMMINGS
FIRMS	METERS	TRUCKS
FENDERS	MOTORCYCLES	TRUCK TRAILERS
GAS TANKS	MUFFLER PARTS	VENTILATORS
	OIL CANS	



ON RAILROADS AND STREET CARS

AIR BRAKE PARTS	FURNITURE	RAILROAD CARS
BAGGAGE TRUCKS	HEADLIGHT PARTS	SIGNAL PARTS
BAGGAGE CHECKS	KITCHEN EQUIPMENT	SIGNAL TOWER PARTS
BRIDGE WORK	LAVATORIES	STREET CARS
CAR HEATERS	LOCOMOTIVES	SWITCH PARTS
CAR REGISTERS	LOCOMOTIVE PARTS	TRANSIT PARTS
DINING CAR EQUIPT.	PASSENGER CARS	WATER TANKS
FREIGHT CARS	PULLMAN CARS	

NEWSTEEL SHEETS



Sheets Serve



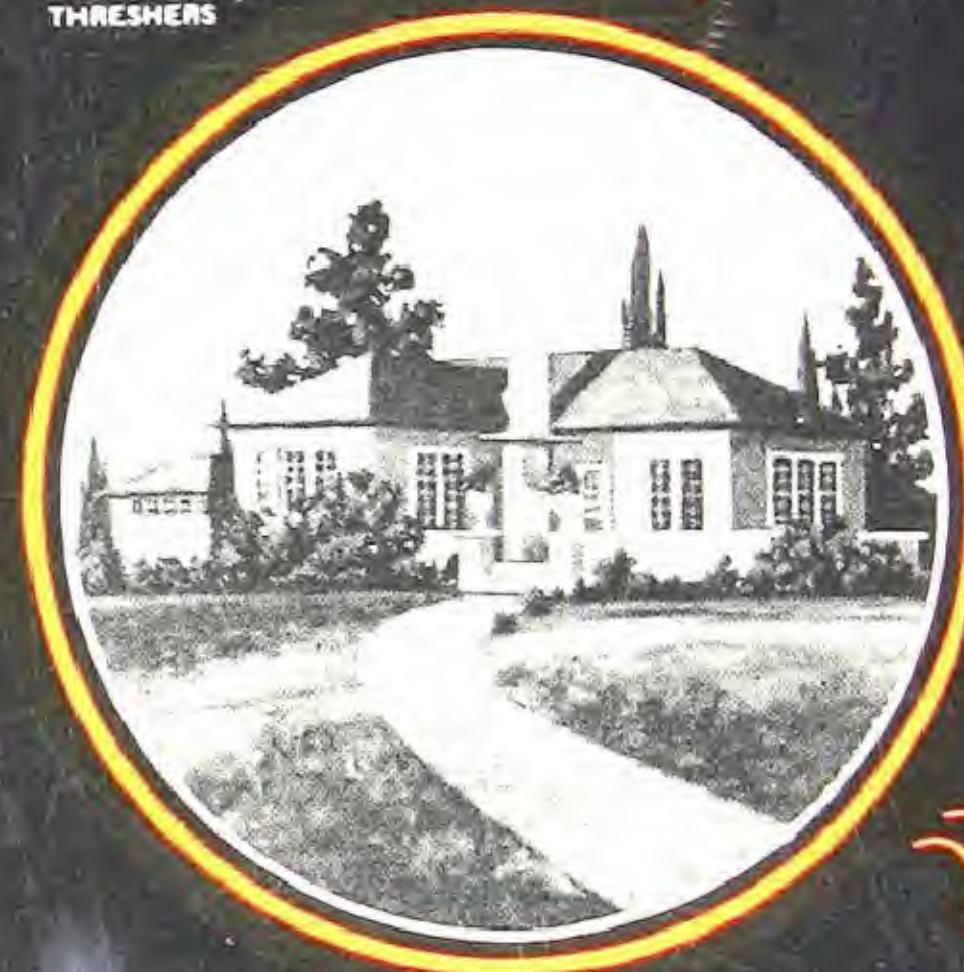
HARDWARE AND SPORTING GOODS

AUTOMOBILE TOOLS	GYMNASIUM EQUIPMENT	SPORTING AND ATHLETIC
BATH-ROOM ACCESSORIES	HEATING ACCESSORIES	GOODS
BICYCLES AND PARTS	HOME HARDWARE	SQUARES AND COMPASSES
BUCKETS	HOTEL EQUIPMENT	STOVES, RANGES AND
BUILDERS' TOOLS	ICE CREAM TOOLS	FURNACES
BUILDING HARDWARE	LEVELS	SWIMMING TANKS
DECOYS	LOCKS	TENNIS RACQUETTES
EDGED TOOLS	MACHINISTS' TOOLS	TINNERS' ACCESSORIES
ELECTRICAL ACCESSORIES	MASONS' TOOLS	TRACK
FISHING TACKLE	OIL CANS	DISCUS
FRUIT STONERS	PLUMBING ACCESSORIES	JUMP BAR FRAMES
GARDEN TOOLS	PUSH PLATES	POLE VAULT BAR
GAUGES	RADIO ACCESSORIES	FRAMES
GUNS AND RIFLES	SCALES	TRAPSHOOTING DEVICES
GUTTERS	SCRAPERS	WHEELBARROWS
	SHOVELS AND SPADES	



ON THE FARM

AGRICULTURAL	HAY SHREDDERS
IMPLEMENTS	MANGERS
CORN CUTTERS	MILK CANS
COW BELLS	MILKING MACHINES
CULTIVATORS	MOWING MACHINES
DAIRY EQUIPMENT	PLANTERS
DEHYDRATORS	SEPARATORS
HARROWS	SILOS
HARVESTERS	THRESHERS



IN THE HOME

ART METAL WORK	KITCHEN CABINETS	RADIO CABINETS
ASH TRAYS	KITCHEN TABLES	SEWING MACHINES AND
BREAD BOXES	LIQUID CONTAINERS	PARTS
CHANDLIER	MAIL BOXES	SHOWER-BATH FIXTURES
CLOCKS	METAL FURNITURE	SOAP DISHES
COOKING UTENSILS	NAME & NUMBER PLATES	SPRINKLERS
ELECTRIC FANS	OIL BURNERS, STOVES,	STOVES AND RANGES
ELECTRICAL APPLIANCES	ETC.	THERMOS BOTTLES
FIREPLACE EQUIPMENT	FANS	TOASTERS
HOT WATER TANKS	PERCOLATORS	TOWEL RACKS
HOUSE HARDWARE	PHONOGRAPH PARTS	TOYS
ICE CREAM FREEZERS	PLUMBING AND FIXTURES	TRAYS
INCINERATORS	PORCH FLOWER BOXES	VACUUM CLEANERS
INKSTANDS	PORCH SWINGS	WASHING MACHINES



ON THE SEA

BINOCULARS	FITTINGS	RAILINGS
BRIDGE APPARATUS	FOG HORNS	RUDDERS
BUOYS	FRESH WATER TANKS	SEARCHLIGHT PARTS
CAPSTANS	GALLEY EQUIPMENT	SHAFTS
CHOCKS	HARDWARE	SIGNAL APPARATUS
CLOCKS	HATCHES	SOUNDING APPARATUS
COLD STORAGE EQUIPT.	HULLS	STEERING MACHINERY
DECK AND CABIN FITTINGS	LAMPS	SUBMARINE PARTS
DIVING APPARATUS	LIFE BOATS	TORPEDO BOXES
DOCK AND HARBOR	NAUTICAL INSTRUMENTS	TURBINES
FRAMES AND DOORS	PERISCOPE PARTS	WHISTLES
ENGINE ROOM	PORT HOLE COVERS	WIRELESS EQUIPMENT
TELEGRAPHS	PUMP PARTS	YACHT FITTINGS



ON THE STREET

AUTOMOBILES	MAIL BOXES	TELEGRAPH APPARATUS
BICYCLES	METAL STORE FRONTS	THEATRE SIGNALS
BUSES	METAL WINDOW FRAMES	TRAFFIC SIGNALS
BURGLAR ALARMS	POLICE BOXES	TROLLEY CARS
ELECTRIC SIGNS	SIDEWALK ASH EJECTORS	TRUCKS
FIRE ENGINES	SIDEWALK ELEVATORS	WATER WAGONS
GASOLINE FILLING	STREET LAMPS	WINDOW DISPLAY STANDS
STATION EQUIPT.		

IN THE THEATRE

ACOUSTIC APPARATUS	FURNITURE	ORGANS
AIR PURIFIERS	LAVATORY EQUIPMENT	SPOT LIGHT APPARATUS
ART METAL WORK	LIGHT REFLECTORS	THEATRE HARDWARE
AUTOMATIC PROGRAM	LOBBY DISPLAY FRAMES	TICKET BOOTHS
ANNOUNCERS	LOBBY EASELS	TICKET BOXES
CLOCKS	METAL FURNITURE	TICKET EJECTORS
EXIT DOORS	MOVING PICTURE	TICKET PUNCHES
FANS	MACHINERY	TURNSTILES
FIRST AID CABINETS	MUSICAL INSTRUMENTS	

NEW STEEL SHEETS





Newsteel Sheets for

If there be such a thing as artistry in working with steel, it is nowhere better exemplified than by its growing and seemingly unlimited use in the manufacturing of household appliances. For the mechanical and almost wholly automatic servants of the modern home are, beyond doubt, the products of a talent that draws nearer every day to an unbelievable wizardry. The cunning and craft of such accomplishments have banished forever the drudgery of house work which has held the women of the world in a rigorous bondage since time began.

Centuries ago the stones of the Tiber afforded the only helpful elements of the Roman wash-day; and pliant fagots, bound to stout tree limbs, made satisfactory brooms.

It is far back, indeed, to these two primitive manifestations of human resourcefulness—stones and wood, with their attendant back-breaking labor. Yet they were the eager, initial efforts toward the achievement of the remarkable appliances which have happily replaced them. They blazed a trail for other devices.

The progress up to the present era had been gradual. Raw materials were discovered at intervals—sometimes by accident—and then





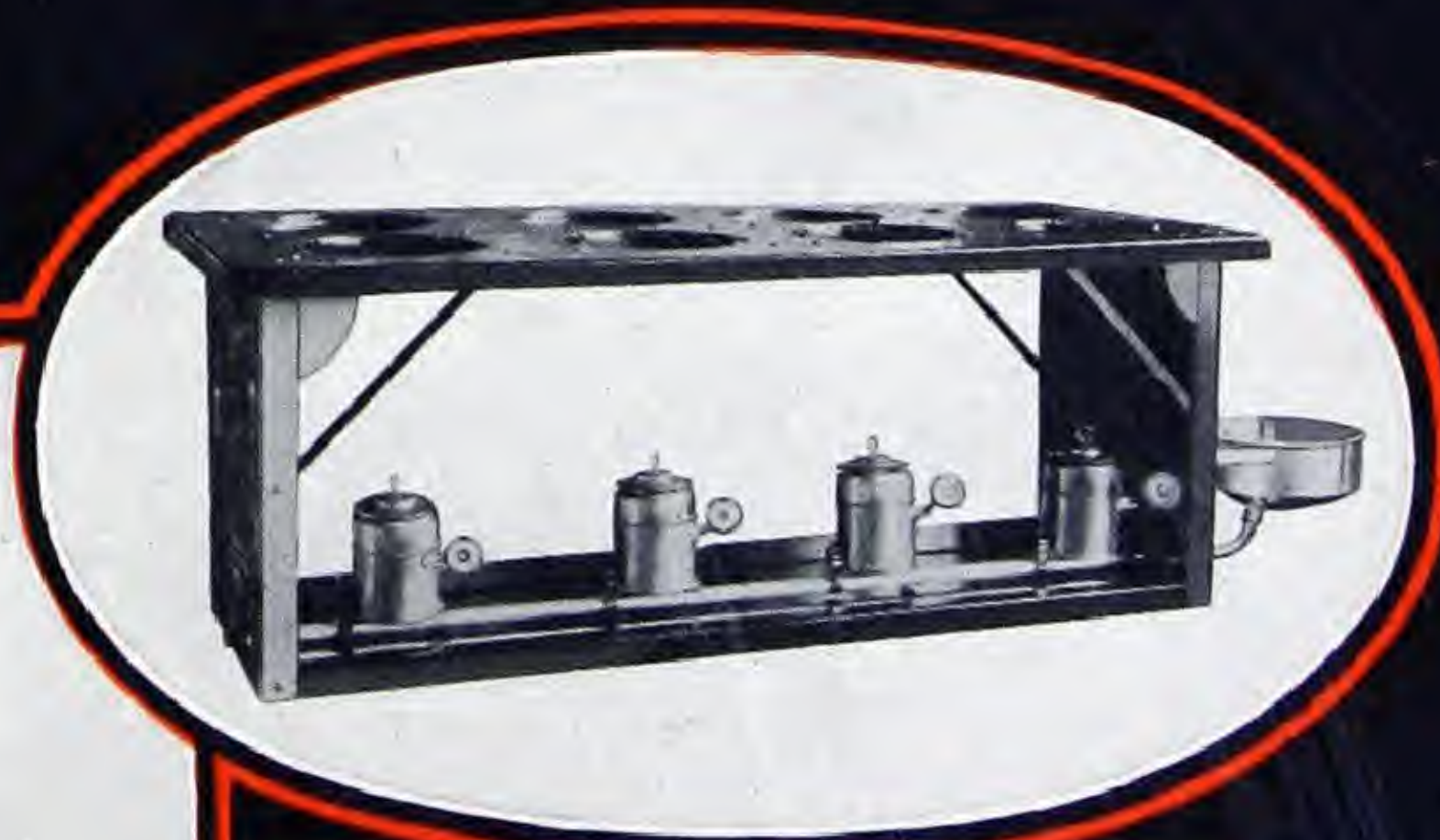
Household Appliances

began the painstaking research to render them into a workable and practicable nature. There were disappointments and failures, but perfection was actually reached with the production of steel sheets—good steel sheets—from which are made efficient labor-saving devices for each domestic duty.

Kitchen cabinets and tables, cooking utensils, fireless cookers, incinerators, and vacuum cleaners answer the daily domestic biddings. Washing machines and similar equipment make short work of laundry time. There are many more of these appliances today—chandeliers, flower stands, bread boxes, mail boxes, clocks, ash trays, radio cabinets, radiator covers, fire-place equipment, and scores in addition—and their number will be greater tomorrow.

They must be strong and unusually durable to successfully withstand their continual usage. The sheet steel from which they are made not only must meet these requirements, but also, in some instances, possess the singular beauty desired in such appliances.

To choose for these purposes Newsteel Sheets—good steel sheets—begins an appreciation that spreads from the fabricator to the ultimate owner.





Newsteel Sheets for



Years back, the preparation of the breakfast toast was an ordeal. The slices were leaned, somehow, against a flame and the cook waited—waited until the slices were slightly tanned, or burned in spots and hard as slate. The little wire toaster that was held over flames came later, and was pronounced a great improvement over the patience method.

Then, too, fireplaces roared mightily during the winter months—and the lazy heat went up the chimney and the smoke came into the room. Water was heated slowly and used sparingly, especially when it had to be carried from pumps.

So it certainly seems to be true that sheet steel—good sheet steel—has fostered no greater need than by its adaptability in providing a material for the construction of heating devices. For the morning toast is now prepared at the breakfast table; and hot water—plenty of it—comes to the early riser in pipes from an automatic heater. And warmth readily can be coaxed out of any one of several devices by turning a knob or pressing a button.

The heating devices of this modern age are great in number, and the future has yet to make its contribution. Consider some of them—electric irons, kitchen stoves, electric





Heating Devices

stoves for heating and cooking, toasters, water heaters, waffle irons, gas stoves, pressing irons, percolators, electric table grills, fireless cookers.

The demands made upon these devices are, by no means, to be looked upon as ordinary. Their services provide comforts that have come to be taken as necessities; and suspensions in their satisfactory workings, quite naturally, create a doubt in the minds of the users. And that doubt might easily create a local buying hesitancy of appreciable effect, for word-of-mouth testimonials travel quickly and do their work well. Where one device fails, others marketed under the same trade mark are endangered.

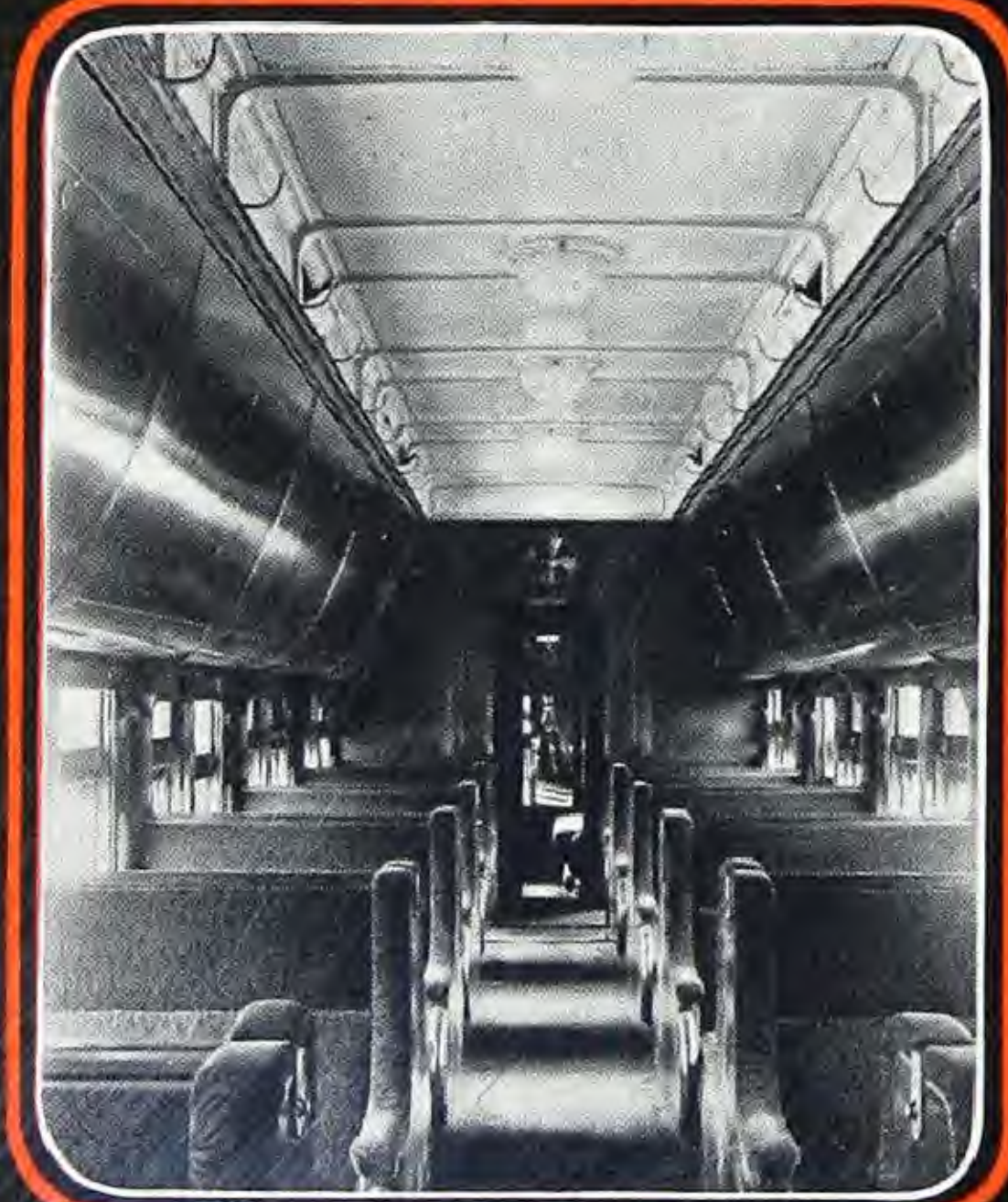
In the manufacture of heating devices, sheet steel is subjected to small punchings, stampings, shapings, and even odd twistings, that cannot be sustained by a material which is not particularly made to meet the stress of these operations. The sheet steel must also remain unaffected by the sudden and gradual heatings and coolings.

Newsteel Sheets—good steel sheets—have proven their worth under every conceivable test in the services which heating devices must render. They have justly earned an appreciation that extends from the heating device fabricators to the admiring purchasers.





Newsteel Sheets for



The old order gives 'way slowly—and there are many who will say that it has taken long for steel to assume its proper place in the world's market for malleable metals. Yet it is not so far back to the first wide use of steel sheets during the early, timid struggles of the automobile industry. And since then, steel has raced to a peak of value not outranked by even precious metals.

Where a new need has called to industry—steel has answered. Prejudices have been overcome. Imagination has rivaled necessity. Yesterday's clumsy contrivances have faded before the developments of last night. And the end—how far away it really is!

Manufacturers, who yesteryear used wood and frail metals in building their products, have turned to sheet steel—good sheet steel—for perfection. The handpower washing machine has vanished; the shop-keeper's wooden cash drawer, with its tinkling bell, has been displaced by the modern register; the electric fan has come into being; river and lake boats have forgotten the oakum-and-tar stage; the automobile improves—all through the use of good steel sheets.

And today the stamping industry finds new





General Uses

uses for this metal. Equipment that formerly yielded two or three articles is turning out a dozen, quickly and efficiently. The small strips, too, are being stamped into missions of service instead of bales of worthless scrap.

As each day draws to a close, some mind has approached or actually found another use for sheet steel, holding the promise of mighty changes, progress, power, riches! A huge plant which last year earned thousands in profits from a wooden toy, may shame that record this year with children's playthings of sheet steel.

What a range of potential uses! What an opportunity for the manufacturer who is beginning to use good steel sheets; and who dares limit those who have already established their mark through its use! From the small tray which receives a negligent ash, to the burial casket of the last solemn sleep, sheet steel plays a role in life that affects the rich and needy, the high and low, the great and the humble.

And there is no other steel sheet—no other good steel sheet—quite so like Newsteel for experiment and trial and splendid realization for the uses and fortunes of mankind!





NEWSTEEL SHEET STANDARDS

QUALITY AND SIZE EXTRAS

Automobile Sheets

Automobile Body Stock	Base 22 Gauge
Automobile Body Stock, Deep Drawing	Add .25 per 100 lbs.
Automobile Body Stock, Extra Deep Drawing	Add .50 per 100 lbs.
Hood, Flat Fender, Door and Apron or Splash Guard Stock	Add .25 per 100 lbs.
Crown Fender, Cowl and Radiator Casing, Extra Deep Drawing	Add .75 per 100 lbs.
21 gauge and lighter—25% seconds included.	
20 gauge and heavier—15% seconds included.	
All seconds invoiced 10% less than prime sheets.	

Metal Furniture Sheets

First and Second Grade Metallic Furniture Stock	Base 28 Gauge
Resquaring	Add 5% (At Time of Resquaring)
Oiling	Add .10 per 100 lbs.
21 gauge and lighter—25% seconds included.	
20 gauge and heavier—15% seconds included.	
All seconds invoiced 10% less than prime sheets.	

GAUGE DIFFERENTIALS (U. S. S.)

Automobile Body Sheets

22 Gauge	Base
17-21 Gauge	Deduct .05 per 100 lbs.
15-16 Gauge	Deduct .10 per 100 lbs.
13-14 Gauge	Deduct .15 per 100 lbs.

Metal Furniture Sheets

28 Gauge	Base
27 Gauge	Deduct .05 per 100 lbs.
25-26 Gauge	Deduct .10 per 100 lbs.
22-24 Gauge	Deduct .15 per 100 lbs.
17-21 Gauge	Deduct .20 per 100 lbs.
15-16 Gauge	Deduct .25 per 100 lbs.
13-14 Gauge	Deduct .30 per 100 lbs.
10-12 Gauge	Deduct .35 per 100 lbs.

Full Pickled, Singled Pickled, and Black

30 Gauge	Add .20 per 100 lbs.
29 Gauge	Add .10 per 100 lbs.
28 Gauge	Base
27 Gauge	Deduct .05 per 100 lbs.
25-26 Gauge	Deduct .10 per 100 lbs.
22-24 Gauge	Deduct .15 per 100 lbs.
17-21 Gauge	Deduct .20 per 100 lbs.
15-16 Gauge	Deduct .25 per 100 lbs.
13-14 Gauge	Deduct .30 per 100 lbs.
10-12 Gauge	Deduct .35 per 100 lbs.

MISCELLANEOUS EXTRAS

Full Cold Rolled and Annealed	Add .25 per 100 lbs.
Single Pickled One Pass Cold Rolled and Annealed	Add .50 per 100 lbs.
Single Pickled Full Cold Rolled and Annealed	Add .60 per 100 lbs.
Deep Stamping or Drawing	Add .25 per 100 lbs.
Extra Deep Stamping or Drawing	Add .50 per 100 lbs.
Roller Leveling	Add .10 per 100 lbs.
Extra Box Annealing	Add .15 per 100 lbs.
Patent or Stretcher Leveling (Not Resquared)	Add .25 per 100 lbs.
Resquaring	5% of Price of Sheet at Time of Resquaring
Oiling	Add .10 per 100 lbs.

Prices for extras effective December 1st, 1925, and subject to change without notice.





NEWSTEEL SHEET STANDARDS

SIZE EXTRAS FOR FIRST AND SECOND GRADE
METAL FURNITURE STOCK, AUTOMOBILE AND FULL
PICKLED SHEETS

Extras for Width

10-16 Gauge Over 36" to 44"	Add .10 per 100 lbs.
10-16 Gauge Over 44" to 48"	Add .20 per 100 lbs.
10-16 Gauge Over 48" to 52"	Add .35 per 100 lbs.
10-16 Gauge Over 52" to 54"	Add .50 per 100 lbs.
17-18 Gauge Over 36" to 44"	Add .20 per 100 lbs.
17-18 Gauge Over 44" to 48"	Add .35 per 100 lbs.
17-18 Gauge Over 48" to 50"	Add .45 per 100 lbs.
17-18 Gauge Over 50" to 54"	Add .75 per 100 lbs.
19-21 Gauge Over 36" to 44"	Add .30 per 100 lbs.
19-21 Gauge Over 44" to 48"	Add .50 per 100 lbs.
19-21 Gauge Over 48" to 50"	Add .60 per 100 lbs.
19-21 Gauge Over 50" to 54"	Add .90 per 100 lbs.
22-24 Gauge Over 36" to 40"	Add .40 per 100 lbs.
22-24 Gauge Over 40" to 44"	Add .80 per 100 lbs.
22-24 Gauge Over 44" to 48"	Add 1.25 per 100 lbs.
10-16 Gauge Under 24" to 12"	Add .10 per 100 lbs.
10-16 Gauge Under 12" to 6"	Add .20 per 100 lbs.
17-24 Gauge Under 24" to 12"	Add .15 per 100 lbs.
17-24 Gauge Under 12" to 6"	Add .25 per 100 lbs.

Extras for Length

10-16 Gauge Over 120" to 132"	Add .05 per 100 lbs.
10-16 Gauge Over 132" to 144"	Add .10 per 100 lbs.
10-16 Gauge Under 60" to 30"	Add .10 per 100 lbs.
10-16 Gauge Under 30" to 18"	Add .15 per 100 lbs.
17-24 Gauge Over 120" to 132"	Add .10 per 100 lbs.
17-24 Gauge Over 132" to 144"	Add .20 per 100 lbs.
17-24 Gauge Under 60" to 30"	Add .15 per 100 lbs.
17-24 Gauge Under 30" to 18"	Add .25 per 100 lbs.

SIZE EXTRAS FOR SINGLE PICKLED, AND BLACK SHEETS

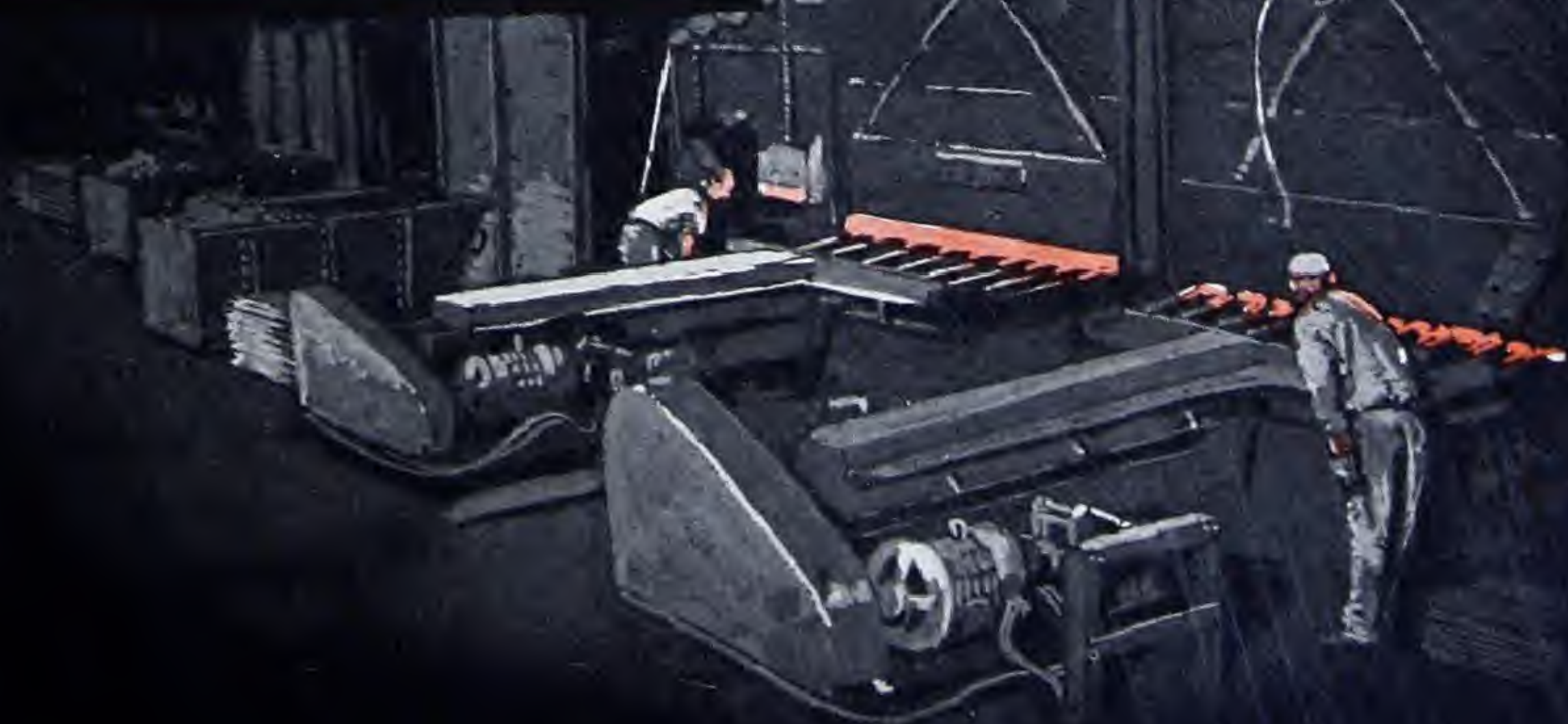
Extras for Width

16 Gauge and Heavier 24" and Wider	None
17-18 Gauge Over 36" to 48"	.05 per 100 lbs.
17-18 Gauge Over 48" to 54"	.10 per 100 lbs.
19-21 Gauge Over 36" to 44"	.15 per 100 lbs.
19-21 Gauge Over 44" to 48"	.25 per 100 lbs.
19-21 Gauge Over 48" to 54"	.40 per 100 lbs.
22-24 Gauge Over 36" to 40"	.20 per 100 lbs.
22-24 Gauge Over 40" to 48"	.40 per 100 lbs.
25-27 Gauge Over 36" to 40"	.20 per 100 lbs.
25-27 Gauge Over 40" to 44"	.40 per 100 lbs.
18 Gauge and Heavier Under 24" to 12"	.10 per 100 lbs.
18 Gauge and Heavier Under 12" to 6"	.15 per 100 lbs.
19 Gauge and Lighter Under 24" to 12"	.10 per 100 lbs.
19 Gauge and Lighter Under 12" to 6"	.20 per 100 lbs.

Extras for Length

16 Gauge and Heavier Over 60" to 144"	None
17 Gauge and Lighter Over 124" to 144"	.10 per 100 lbs.
18 Gauge and Heavier Under 60" to 30"	.05 per 100 lbs.
18 Gauge and Heavier Under 30" to 18"	.10 per 100 lbs.
19 Gauge and Lighter Under 60" to 30"	.10 per 100 lbs.
19 Gauge and Lighter Under 30" to 18"	.20 per 100 lbs.

Prices for extras effective December 1st,
1925, and subject to change without notice.





GAUGES, THICKNESSES AND WEIGHTS

No. of Gauge	Approximate Thickness in Fractions of an Inch U. S. Gauge	Thickness in Decimal Part of an Inch			Thickness in Millimeters
		U. S. Standard	Birmingham or Stubbs	B. & S. or American	U. S. Standard
0000000	1/2	.5	....	.....	12.7
000000	15/32	.46875	....	.....	11.90625
00000	7/16	.4375	....	.....	11.1125
0000	13/32	.40625	.454	.46	10.31875
000	3/8	.375	.425	.4096	9.525
00	11/32	.34375	.38	.3648	8.73125
0	5/16	.3125	.34	.3249	7.9375
1	9/32	.28125	.3	.2893	7.14375
2	17/64	.265625	.284	.2576	6.746375
3	1/4	.25	.259	.2294	6.35
4	15/64	.234375	.238	.2043	5.953125
5	7/32	.21875	.22	.1819	5.55625
6	13/64	.203125	.203	.1620	5.159375
7	3/16	.1875	.18	.1443	4.7625
8	11/64	.171875	.165	.1285	4.365625
9	5/32	.15625	.148	.1144	3.96875
10	9/64	.140625	.134	.1019	3.571875
11	1/8	.125	.12	.0907	3.175
12	7/64	.109375	.109	.0808	2.778125
13	3/32	.09375	.095	.0720	2.38125
14	5/64	.078125	.083	.0641	1.984375
15	9/128	.0703125	.072	.0571	1.7859375
16	1/16	.0625	.065	.0508	1.5875
17	9/160	.05625	.058	.0453	1.42875
18	1/20	.05	.049	.0403	1.27
19	7/160	.04375	.042	.0359	1.11125
20	3/80	.0375	.035	.0320	.9525
21	11/320	.034375	.032	.0285	.873125
22	1/32	.03125	.028	.0253	.79375
23	9/320	.028125	.025	.0226	.714375
24	1/40	.025	.022	.0201	.635
25	7/320	.021875	.02	.0179	.555625
26	3/160	.01875	.018	.0159	.47625
27	11/640	.0171875	.016	.0142	.4365625
28	1/64	.015625	.014	.0126	.396875
29	9/640	.0140625	.013	.0113	.3571875
30	1/80	.0125	.012	.0100	.3175
31	7/640	.0109375	.01	.0089	.2778125
32	13/1280	.01015625	.009	.0080	.25796875
33	3/320	.009375	.008	.0071	.238125
34	11/1280	.00859375	.007	.0063	.21828125
35	5/640	.0078125	.005	.0056	.1984375
36	9/1280	.00703125	.004	.005	.17859375
37	17/2560	.006640625	....	.0044	.168671875
38	1/160	.00625	....	.0039	.15875





GAUGES, THICKNESSES AND WEIGHTS

Thickness in Millimeters		Weight in Pounds per Square Foot			
Birmingham or Stubbs	B. & S. or American	U. S. Standard	Birmingham or Stubbs	B. & S. or American	No. of Gauge
.....	.....	20.00	.....	.....	0000000
.....	.....	18.75	.....	.....	000000
.....	.....	17.50	.....	.....	00000
11.53	11.68	16.25	18.22	18.40	0000
10.79	10.40	15.00	17.05	16.38	000
9.651	9.266	13.75	15.25	14.59	00
8.635	8.252	12.50	13.64	13.00	0
7.619	7.348	11.25	12.04	11.57	1
7.213	6.543	10.625	11.40	10.30	2
6.578	5.827	10.00	10.39	9.18	3
6.045	5.189	9.375	9.55	8.17	4
5.587	4.620	8.75	8.83	7.28	5
5.156	4.115	8.125	8.15	6.48	6
4.572	3.665	7.5	7.22	5.77	7
4.19	3.264	6.875	6.62	5.14	8
3.759	2.906	6.25	5.94	4.58	9
3.403	2.588	5.625	5.38	4.08	10
3.047	2.304	5.00	4.82	3.63	11
2.768	2.052	4.375	4.37	3.23	12
2.413	1.829	3.75	3.81	2.88	13
2.108	1.628	3.125	3.33	2.56	14
1.829	1.450	2.8125	2.89	2.28	15
1.651	1.290	2.5	2.61	2.03	16
1.473	1.151	2.25	2.33	1.81	17
1.244	1.024	2.00	1.97	1.61	18
1.067	.911	1.75	1.69	1.44	19
.889	.813	1.50	1.40	1.28	20
.813	.724	1.375	1.28	1.14	21
.711	.643	1.25	1.12	1.01	22
.635	.574	1.125	1.00	.904	23
.559	.511	1.00	.883	.804	24
.508	.455	.875	.803	.716	25
.457	.404	.75	.722	.636	26
.406	.361	.6875	.642	.568	27
.356	.320	.625	.562	.504	28
.33	.287	.5625	.522	.452	29
.305	.254	.5	.482	.400	30
.254	.226	.4375	.401	.356	31
.229	.203	.40625	.361	.320	32
.203	.180	.375	.321	.284	33
.177	.160	.34375	.281	.252	34
.127	.142	.3125	.201	.224	35
.102	.....	.218125	.161	.....	36
.....	.....	.265625	.....	.....	37
.....	.....	.25	.....	.....	38





WEIGHTS OF BLUE ANNEALED SHEETS

To find the weight of any sheet of known dimensions, multiply the length of the sheet in inches by the number indicated in the table opposite its corresponding gauge and width.
For example—A sheet 20 gauge, 21" x 104", weighs 104 times .2188, or 22.7552 pounds.

Gauge	Width in Inches								
	20	21	22	23	24	25	26	27	28
7	1.0417	1.0937	1.1458	1.1979	1.2500	1.3021	1.3542	1.4062	1.4583
8	.9548	1.0026	1.0503	1.0981	1.1458	1.1936	1.2413	1.2890	1.3368
9	.8680	.9115	.9549	.9983	1.0417	1.0851	1.1285	1.1719	1.2153
10	.7812	.8203	.8594	.8984	.9375	.9766	1.0156	1.0547	1.0937
11	.6944	.7292	.7639	.7986	.8333	.8681	.9028	.9375	.9722
12	.6076	.6380	.6684	.6988	.7292	.7596	.7899	.8203	.8507
13	.5208	.5469	.5729	.5990	.6250	.6510	.6771	.7031	.7292
14	.4340	.4557	.4774	.4991	.5208	.5425	.5642	.5859	.6076
15	.3906	.4102	.4297	.4492	.4687	.4883	.5078	.5273	.5469
16	.3472	.3646	.3819	.3993	.4167	.4340	.4514	.4688	.4861
17	.3125	.3281	.3437	.3594	.3750	.3906	.4062	.4219	.4375
18	.2778	.2917	.3056	.3194	.3333	.3472	.3611	.3750	.3889
19	.2431	.2552	.2674	.2795	.2917	.3038	.3160	.3281	.3403
20	.2083	.2188	.2292	.2396	.2500	.2604	.2708	.2813	.2917
21	.1910	.2005	.2101	.2196	.2292	.2387	.2483	.2578	.2674
22	.1736	.1823	.1910	.1996	.2083	.2170	.2257	.2344	.2431
23	.1562	.1641	.1719	.1797	.1875	.1953	.2031	.2109	.2187
24	.1389	.1458	.1528	.1597	.1667	.1736	.1806	.1875	.1944
25	.1215	.1276	.1337	.1398	.1458	.1519	.1580	.1641	.1701
26	.1042	.1094	.1146	.1198	.1250	.1302	.1354	.1406	.1458
27	.0955	.1003	.1050	.1098	.1146	.1194	.1241	.1289	.1337
28	.0868	.0911	.0955	.0998	.1042	.1085	.1129	.1172	.1215
29	.0781	.0820	.0859	.0898	.0938	.0977	.1016	.1055	.1094
30	.0694	.0729	.0764	.0799	.0833	.0868	.0903	.0938	.0972

Gauge	Width in Inches								
	29	30	31	32	33	34	35	36	37
7	1.5104	1.5625	1.6146	1.6667	1.7187	1.7708	1.8229	1.8750	1.9271
8	1.3845	1.4323	1.4800	1.5278	1.5755	1.6232	1.6710	1.7187	1.7665
9	1.2587	1.3021	1.3455	1.3889	1.4323	1.4757	1.5191	1.5625	1.6059
10	1.1328	1.1719	1.2109	1.2500	1.2891	1.3281	1.3672	1.4062	1.4453
11	1.0069	1.0417	1.0764	1.1111	1.1458	1.1805	1.2153	1.2500	1.2847
12	.8811	.9115	.9418	.9722	1.0026	1.0330	1.0634	1.0938	1.1241
13	.7552	.7812	.8073	.8333	.8594	.8854	.9115	.9375	.9635
14	.6293	.6510	.6727	.6944	.7161	.7378	.7595	.7812	.8029
15	.5664	.5859	.6055	.6250	.6445	.6641	.6836	.7031	.7227
16	.5035	.5208	.5382	.5556	.5729	.5903	.6075	.6250	.6424
17	.4531	.4687	.4844	.5000	.5156	.5312	.5469	.5625	.5781
18	.4028	.4167	.4306	.4444	.4583	.4722	.4861	.5000	.5139
19	.3524	.3646	.3767	.3889	.4010	.4132	.4253	.4375	.4497
20	.3021	.3125	.3229	.3333	.3438	.3542	.3646	.3750	.3854
21	.2769	.2865	.2960	.3056	.3151	.3247	.3342	.3438	.3533
22	.2517	.2604	.2691	.2778	.2865	.2951	.3038	.3125	.3212
23	.2266	.2344	.2422	.2500	.2578	.2656	.2734	.2812	.2891
24	.2014	.2083	.2153	.2222	.2292	.2361	.2431	.2500	.2569
25	.1762	.1823	.1884	.1944	.2005	.2066	.2127	.2188	.2248
26	.1510	.1563	.1615	.1667	.1719	.1771	.1823	.1875	.....
27	.1385	.1432	.1480	.1528	.1576	.1623	.1671	.1719	.....
28	.1259	.1302	.1346	.1389	.1432	.1476	.1519	.1563	.....
29	.1133	.1172	.1211	.1250	.1289	.1328	.1367	.1406	.....
30	.1007	.1042	.1076	.1111	.1146	.1181	.1215	.1250	.....



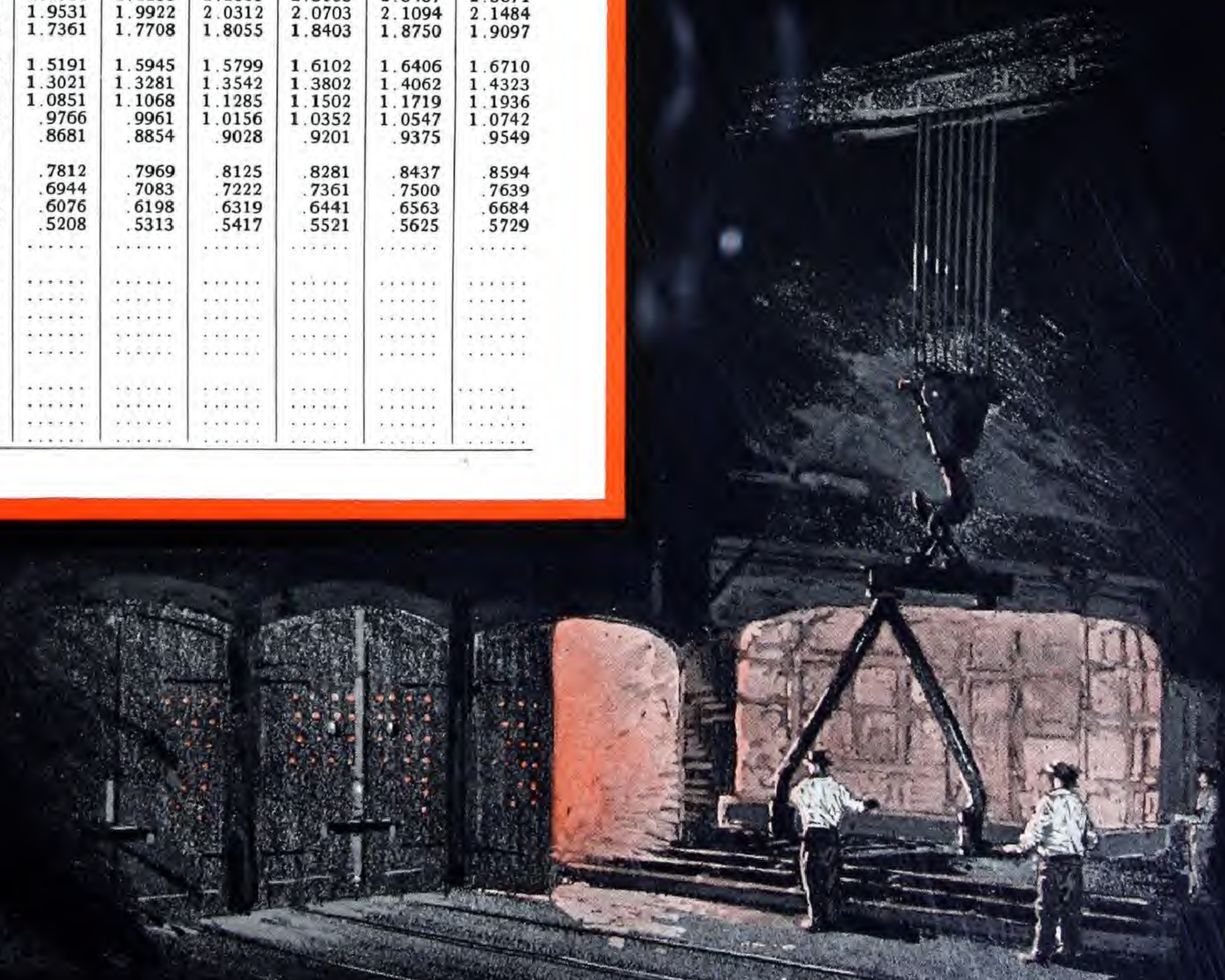


WEIGHTS OF BLUE ANNEALED SHEETS

—Continued

Gauge	Width in Inches								
	38	39	40	41	42	43	44	45	46
7	1.9792	2.0312	2.0833	2.1354	2.1875	2.2396	2.2917	2.3437	2.3958
8	1.8142	1.8620	1.9097	1.9574	2.0052	2.0529	2.1007	2.1484	2.1962
9	1.6493	1.6927	1.7361	1.7795	1.8229	1.8663	1.9097	1.9531	1.9965
10	1.4844	1.5234	1.5625	1.6016	1.6406	1.6797	1.7187	1.7578	1.7969
11	1.3194	1.3542	1.3889	1.4236	1.4583	1.4930	1.5278	1.5625	1.5972
12	1.1545	1.1849	1.2153	1.2457	1.2760	1.3064	1.3368	1.3672	1.3976
13	.9896	1.0156	1.0417	1.0677	1.0937	1.1198	1.1458	1.1719	1.1979
14	.8246	.8463	.8680	.8897	.9115	.9332	.9549	.9766	.9983
15	.7422	.7617	.7812	.8008	.8203	.8398	.8594	.8789	.8984
16	.6597	.6771	.6944	.7118	.7292	.7465	.7639	.7813	.7986
17	.5937	.6094	.6250	.6406	.6562	.6719	.6875	.7031	.7187
18	.5278	.5417	.5556	.5694	.5833	.5972	.6111	.6250	.6389
19	.4618	.4740	.4861	.4983	.5104	.5226	.5347	.5469	.5590
20	.3958	.4063	.4167	.4271	.4375	.4479	.4583	.4688	.4792
21	.3629	.3724	.3820	.3915	.4010	.4106	.4201	.4297	.4392
22	.3299	.3385	.3472	.3559	.3646	.3733	.3819	.3906	.3993
23	.2969	.3047	.3125	.3203	.3281	.3359	.3437	.3516	.3594
24	.2639	.2708	.2778	.2847	.2917	.2986	.3056	.3125	.3194
25	.2309	.2370	.2431	.2491	.2552	.2613	.2674		
26									
27									
28									
29									
30									

Gauge	Width in Inches								
	47	48	49	50	51	52	53	54	55
7	2.4479	2.5000	2.5521	2.6042	2.6562	2.7083	2.7604	2.8125	2.8646
8	2.2439	2.2916	2.3394	2.3871	2.4349	2.4826	2.5303	2.5781	2.6258
9	2.0399	2.0833	2.1267	2.1701	2.2135	2.2569	2.3003	2.3437	2.3871
10	1.8359	1.8750	1.9141	1.9531	1.9922	2.0312	2.0703	2.1094	2.1484
11	1.6319	1.6667	1.7014	1.7361	1.7708	1.8055	1.8403	1.8750	1.9097
12	1.4280	1.4583	1.4887	1.5191	1.5495	1.5799	1.6102	1.6406	1.6710
13	1.2240	1.2500	1.2760	1.3021	1.3281	1.3542	1.3802	1.4062	1.4323
14	1.0200	1.0417	1.0634	1.0851	1.1068	1.1285	1.1502	1.1719	1.1936
15	.9180	.9375	.9570	.9766	.9961	1.0156	1.0352	1.0547	1.0742
16	.8160	.8333	.8507	.8681	.8854	.9028	.9201	.9375	.9549
17	.7344	.7500	.7656	.7812	.7969	.8125	.8281	.8437	.8594
18	.6528	.6667	.6806	.6944	.7083	.7222	.7361	.7500	.7639
19	.5712	.5833	.5955	.6076	.6198	.6319	.6441	.6563	.6684
20	.4896	.5000	.5104	.5208	.5313	.5417	.5521	.5625	.5729
21	.4488	.4583							
22	.4080	.4167							
23	.3672	.3750							
24	.3264	.3333							
25									
26									
27									
28									
29									
30									





CIRCUMFERENCES AND AREAS OF CIRCLES

Inches or Feet								
Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area
1	3.1416	.7854	43	135.09	1452.20	85	267.04	5674.50
2	6.2832	3.1416	44	138.23	1520.53	86	270.18	5808.80
3	9.4248	7.0686	45	141.37	1590.43	87	273.32	5944.68
4	12.5664	12.5664	46	144.51	1661.90	88	276.46	6082.12
5	15.7080	19.635	47	147.65	1734.94	89	279.60	6221.14
6	18.850	28.274	48	150.80	1809.56	90	282.74	6361.73
7	21.991	38.485	49	153.94	1885.74	91	285.88	6503.88
8	25.133	50.266	50	157.08	1963.50	92	289.03	6647.61
9	28.274	63.617	51	160.22	2042.82	93	292.17	6792.91
10	31.416	78.540	52	163.36	2123.72	94	295.31	6939.78
11	34.558	95.033	53	166.50	2206.18	95	298.45	7088.22
12	37.699	113.1	54	169.65	2290.22	96	301.59	7238.23
13	40.841	132.73	55	172.79	2375.83	97	304.73	7339.81
14	43.982	153.94	56	175.93	2463.01	98	307.88	7542.96
15	47.124	176.71	57	179.07	2551.76	99	311.02	7697.69
16	50.265	201.06	58	182.21	2642.08	100	314.16	7853.98
17	53.407	226.98	59	185.35	2733.97	101	317.30	8011.85
18	56.549	254.47	60	188.50	2827.43	102	320.44	8171.28
19	59.690	283.53	61	191.64	2922.47	103	323.58	8332.29
20	62.832	314.16	62	194.78	3019.07	104	326.73	8494.87
21	65.973	346.36	63	197.92	3117.25	105	329.87	8659.01
22	69.115	380.13	64	201.06	3216.99	106	333.01	8824.73
23	72.257	415.48	65	204.20	3318.31	107	336.15	8992.02
24	75.398	452.39	66	207.34	3421.19	108	339.29	9160.88
25	78.540	490.87	67	210.49	3525.65	109	342.43	9331.32
26	81.681	530.93	68	213.63	3631.68	110	345.58	9503.32
27	84.823	572.56	69	216.77	3739.28	111	348.72	9676.89
28	87.965	615.75	70	219.91	3848.45	112	351.86	9852.03
29	91.106	660.52	71	223.05	3959.19	113	355	10028.75
30	94.248	706.86	72	226.19	4071.50	114	358.14	10207.03
31	97.389	754.77	73	229.34	4185.39	115	361.28	10386.89
32	100.53	804.25	74	232.48	4300.84	116	364.42	10568.32
33	103.67	855.30	75	235.62	4417.86	117	367.57	10751.32
34	106.81	907.92	76	238.76	4536.47	118	370.71	10935.88
35	109.96	962.11	77	241.90	4656.63	119	373.85	11122.02
36	113.10	1017.88	78	245.04	4778.36	120	376.99	11309.73
37	116.24	1075.21	79	248.19	4901.67	121	380.13	11499.01
38	119.38	1134.11	80	251.33	5026.55	122	383.27	11689.87
39	122.52	1194.59	81	254.47	5153	123	386.42	11882.29
40	125.66	1256.64	82	257.61	5281.02	124	389.56	12076.28
41	128.81	1320.25	83	260.75	5410.61	125	392.70	12271.85
42	131.95	1385.44	84	263.89	5541.77	126	395.84	12468.98

To find diameter of a circle when circumference is given, multiply the given circumference by .3183.

To find the circumference of a circle when diameter is given, multiply the given diameter by 3.1416.





TOLERANCES IN THE ROLLING OF STEEL SHEETS

Causes of Variations from Gauge
and Reasons for Current Practice Presented
from the Mill Standpoint

BY "MILLMAN"

JUDGING from the amount of discussion we hear and the difference of opinion expressed, the matter of variations from gauge in both weight and thickness of iron and steel sheets manufactured by the hot rolling method is one that might be better understood by a great many consumers.

The consumption of hot rolled sheets in their many finishes amounts to perhaps a tenth to an eighth of all iron and steel products produced in this country and their value is greater than that of any other iron or steel product except pig iron and ingots. It would appear, therefore, that all factors affecting the uniformity of the product of such a vast industry, factors that cannot be absolutely controlled, should be explained and a mutual understanding reached.

The actual variation in weight or thickness of sheets from those given in the United States Standard gauge table is perhaps responsible for more misunderstanding and consequently a greater number of complaints and claims than any other single condition of the material. Flat and corrugated sheets are nearly always sold by the manufacturer on the per 100-lb. price basis. The purchaser, whether fabricator or jobber, frequently disposes of them on a basis other than weight, and therefore is vitally interested in the gauge variation. If the sheets are heavier than gauge the profit is reduced; if lighter, there will be an increase in profit providing the product is not too light to be acceptable.

Sheets rolled lighter than gauge are not as productive of complaints as are those rolled heavier than gauge. As a result it would be perfectly natural for manufacturers to make the variation on the side of lightness, but usually they do not do this unless so ordered. When purchasers order that sheets be rolled light to gauge the manufacturer is immediately confronted with the necessity of aiming at a mean weight somewhat less than that corresponding to the nearest gauge. As a result the weight aimed at becomes the gauge ordered and the sheet will not finish within what may be considered the permissible variation from the gauge nearest that ordered. Sometimes this is a cause of misunderstanding. If we consider the methods employed in manufacturing hot rolled sheets and also the several transforming processes through which the metal must pass from the ingot to the bar, we may be less inclined to wonder why they cannot be made more accurate in weight and thickness than to marvel that human hands and ingenuity, in spite of all the difficulties, can create so uniform a product.

Beginning with the Sheet Bar

One of the first steps is to make a sheet bar from which to roll the sheets. Usually two sheets of 24 gauge and lighter are made from one bar, but rarely, except in very short lengths, can more than one sheet of a heavier gauge be made from one bar. Bars 8" wide are invariably used in making sheets 14 gauge and lighter. The

length of the sheet required governs the thickness of the bar and the width of the sheet governs the length of the bar. When a bar has been rolled into as nearly as possible the size and weight of sheet required, both sides and both ends of the sheet will be irregular, ragged and tapered to an almost knife edge. This is due to the metal, which, while being rolled in a red hot state, is being squeezed out just as a batch of dough would be under a rolling pin. It is necessary to shear off these sides and ends and have the dimensions after shearing approximately equal (not scant) to the dimensions of the sheet ordered. The entire lot of sheets of each size must also average in weight, when ordered by gauge number, an amount approximately the United States standard gauge table weight of an equal area.

Determining Bar Size

The loss sustained by shearing the sides and ends is known as hot mill scrap loss, and although its percentage is greater on small sizes and less on large sizes it is estimated to average about 14 per cent of the weight of the sheet before shearing.

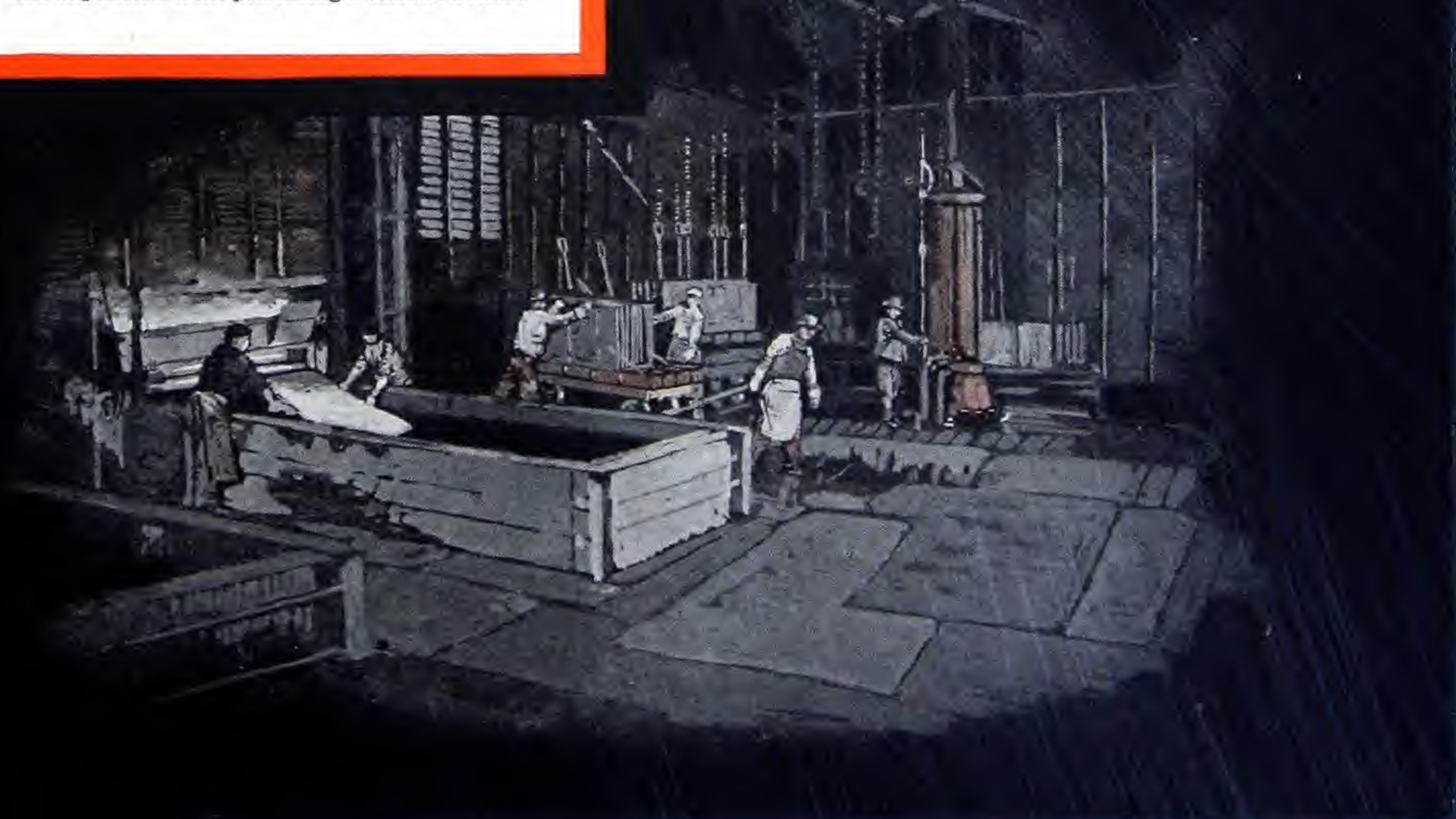
When ordering sheet bar the weight of the finished sheet is first estimated by using the United States standard gauge table and adding a sufficient percentage to cover the estimated hot mill scrap loss. This is factor No. 2 affecting weight and thickness.

To illustrate; if the sheet to be made is 20 gauge 24" wide by 96" long it should weigh 24 lbs. and the bar should weigh about 28 lb. The bar would be made 8" wide by 25½" long. It is rolled sideways on the sheet mill and must be long enough to make the width of the finished sheet plus the side scrap, and thick enough to make the length of the sheet plus the end scrap.

The bars are made as carefully and as accurately as possible, but it is not practical to make them to the exact weight required, because the only way of reducing to weight and thus changing them from a large piece of metal to the dimensions wanted is by reducing the width and thickness by rolling; consequently the weight of the bar is ascertained by measuring the thickness. When the bar is measured it may be a little too thick and because of this, if given another pass through the rolls may, in spite of all possible care, be made a little too thin and too light. This affects the weight and thickness of the sheets—factor No. 3.

Hot Mill Rolling

In either event the bar is made and brought to the hot sheet mills where it is reheated in pair furnaces and started through the rolls. These rolls become very hot as a result of having hot bars pass through them continually and are subject to a considerable expansion, especially in the center, which gets the hottest. To keep this expansion from producing a convex surface





on the rolls, which would result in the center of the sheets being much thinner than the edges and perhaps also in breaking the rolls from uneven pressure, the latter are machined to a slightly convex surface. This expansion is another factor affecting the variation in weight and thickness of sheets.

At the hot sheet mills the thickness and weight of the sheets are determined and regulated by measuring their length with a rod as often as may be necessary. It is not practical to measure the thickness as at the bar mill, because they are not rolled singly as are bars but are rolled in pairs or packs. One pass too few will result in sheets being too heavy and perhaps too short, and the next pass may make them too thin and consequently too light—factor No. 5 to be reckoned with in controlling gauge variation.

Many sheets in the finish wanted require to be bar pickled or sheet pickled or both, and to be highly cold rolled. Since these pickling processes by removing scale from the metal also remove weight, this amount of weight must be predetermined and added to the weight of the sheet bar required—factor No. 6 affecting gauge variation.

Cold Rolling

The surface of a sheet is made very largely by the amount of cold rolling given and it is not always possible to predetermine accurately the number of passes the sheet must have through the cold rolls. Cold rolling elongates the sheets and thus reduces the thickness and the weight per square foot. An allowance is estimated and made for this elongation, when shearing the ends at the hot mill; but as a result of the cold rolling, the thickness and weight per square foot may be seriously affected—factor No. 7 affecting gauge variation.

It would seem that these factors or conditions (and they are not all) are of themselves sufficient to justify a more liberal weight variation than that which exists.

The United States standard gauge is a weight gauge established many years ago by Congressional enactment. It has been standardized by usage rather than by law and has gradually superseded almost entirely Brown & Sharpe gauge, Birmingham wire gauge, British standard gauge and any other gauges that were once frequently used. The decimal equivalent shown in the United States standard gauge table are those of wrought iron, which has been determined to weigh 0.2778 lb. per cu. in., while rolled steel weighs 0.2833 lb. per cu. in. The table, therefore, is somewhat confusing, since wrought iron has been almost entirely superseded by rolled steel. This confusion would not exist, however, if one would dissociate the decimal equivalents from the weights when ordering rolled steel.

Reasons for Over-Size

Assuming that the percentage variations agreed to by manufacturers of hot rolled steel and iron sheets are practicable and are to govern the rolling of the sheets, let us consider some other factors which cannot be avoided and which the purchaser should recognize when determining whether the material received is a good delivery in this respect.

Since a cubic inch of rolled steel weighs 0.2833 lb. and a cubic inch of wrought iron weighs 0.2778 lb. the former is 2 per cent heavier than the latter. Sheets are first sheared at the hot mill and

not again unless ordered re-squared or ordered in smaller sizes than those in which they are rolled. Unless ordered re-squared they cannot be cut accurately to size by hot mill shearing, due to the fact that the sides and ends are irregular as a result of hot rolling and they are not very flat, as they have not yet been annealed or cold rolled. Sheets that are scant to size ordered are not a good delivery, so that an effort is usually made to shear a little over-size. An average over-size of $\frac{1}{4}$ in. in width and $\frac{3}{4}$ in. in length is considered good mill practice. The over-size on some of the large sheets may average a little more. This average over-size represents:

1.6 per cent of a 30 in. x 96 in. area
1.8 per cent of a 24 in. x 96 in. area

2.5 per cent of the length on pickled sheets so that when comparing the actual weight of a lot of sheets of any given size with the United States standard gauge weight, the actual area of the lot should be ascertained by measurement rather than, for example, by assuming that the area of a not re-squared sheet ordered 30 x 96 in. is 20 Sq. Ft.; it will probably be a little more.

Manufacturers' Schedule of Variations

American sheet manufacturers have agreed that the following variations shall be permissible when sheets are ordered to weight per sq. ft.:

16 gauge and heavier, 5 per cent plus or minus
17 gauge and lighter, $2\frac{1}{2}$ per cent plus or minus and that these variations shall apply to the total weight of each lot (all of a gauge and size) in each shipment and not to each individual sheet. It is easy to understand that small selected lots as sold from a jobber's floor may or may not be representative of the weight of the entire lot, because some sheets will be bound to vary in thickness and in weight more than others.

Bundles are usually weighed and the weight marked thereon after being banded. Bands will average about 1 lb. each and from two to three are placed around each bundle, thus adding at least 1.2 per cent to the theoretical weight of the sheets. Therefore, hot rolled one pass cold rolled box annealed sheets or galvanized sheets loose may weigh heavier than theoretical weight, when ordered by weight, due to the following factors:

	Per Cent
17 gauge and lighter, allowable variation.....	2.5
17 gauge and lighter, size variation, $\frac{1}{4}$ x $\frac{3}{4}$ in.	1.6
Total variation.....	4.1
without any allowance for variation in scale weight.	

Hot rolled one pass cold rolled box annealed or galvanized sheets banded may weigh heavier than theoretical weight, due to the following factors:

	Per Cent
17 gauge and lighter, allowable variation.....	2.5
17 gauge and lighter, size variation, $\frac{1}{4}$ x $\frac{3}{4}$ in.	1.6
17 gauge and lighter, weight of bands.....	1.2
Total variation.....	5.3

Therefore, 18 gauge and lighter one pass cold rolled box annealed or galvanized loose sheets, when ordered by weight, may weigh 4.1 per cent heavier than theoretical weight and yet be considered within the allowable variation; and 17 gauge and lighter banded sheets may weigh 5.3 per cent heavier than theoretical weight and





also be considered within the allowable variation.

By the same method of calculation, 16 gauge and heavier loose sheets may weigh 6.6 per cent more than theoretical weight and when banded 7.8 per cent more than theoretical weight. As a matter of fact they do not average to these upper limits because some are light, thus offsetting the heavy ones, and the purchaser thus gets an advantage.

To the above variations, which are entirely reasonable, should be added, when sheets are ordered to decimal thickness, the 2 per cent difference in weight between wrought iron and rolled steel, in determining the permissible weight of common black steel sheets.

Full Pickled and Cold Rolled Sheets

Carefully made tests show conclusively that full pickled, full cold rolled sheets weigh at least two per cent more than do common black sheets of the same thickness. The reason for this is perhaps chiefly that the former has had the scale removed and surface irregularities smoothed. Scale is much lighter than steel, consequently when it is removed the weight of the sheet is not decreased in proportion to the reduction in thickness. Two or three passes in the cold rolls will fill up the pores and pits created by pickling, thus again slightly reducing the thickness by pressing the surrounding metal into them, without reducing the weight.

Therefore, is it not reasonable to assume that the maximum variation might easily be approximately as follows:

One Pass Cold Rolled, Box Annealed or Galvanized

- 16 gauge and heavier, loose, ordered to weight, 6.6 per cent; ordered to thickness, 8.6 per cent.
- 16 gauge and heavier, banded, ordered to weight, 7.8 per cent; ordered to thickness, 9.8 per cent.
- 17 gauge and lighter, loose, ordered to weight, 4.1 per cent; ordered to thickness, 6.1 per cent.
- 17 gauge and lighter, banded, ordered to weight, 5.3 per cent; ordered to thickness, 7.3 per cent.

Full Pickled, Full Cold Rolled

- 16 gauge and heavier, loose, ordered to weight, 6.6 per cent; ordered to thickness, 10.6 per cent.
- 17 gauge and lighter, loose, ordered to weight, 4.1 per cent; ordered to thickness 8.1 per cent.

These sheets are seldom ordered bundled.

When sheets are ordered by gauge number they are rolled as near as possible to the weight per square foot corresponding to that gauge number. When they are ordered by decimal thickness, as are a great many full pickled, full finished sheets, they are rolled as near to the decimal thickness as possible, and as a result they will average heavier per sq. ft. than if rolled to weight.

No kind of a sheet, whether wrought iron, rolled steel or full pickled, full cold rolled and annealed, need be any heavier per sq. ft. than any other if ordered by and rolled to weight, as the difference would be in thickness only. But if rolled to decimal thickness wrought iron would be the lightest, rolled steel next to F.P., C.R. and A. steel would be heaviest per sq. ft.

Further Cold Rolling

Additional cold rolling in excess of 2 passes reduces weight per sq. ft. and thickness nearly in the same proportion. The pits and pores having been filled, the metal under pressure having to go somewhere necessarily flows.

A full pickled, full cold rolled sheet made to a decimal thickness that is determined by the usual method—namely, using short jawed calipers—will weigh from one to two per cent more per sq. ft. when ordered not re-squared than when ordered re-squared. This fact is due to a feathering of the edge in cold rolling, similar to though not in the same degree as a knife edge produced in hot rolling.

Thickness determinations made along the edge of the sheet will average a little thinner if taken before re-squaring than after. While this does make a difference sheet manufacturers do not make it a basis of claim.

When in ordering a sheet the gauge is indicated by decimal thickness then the individual sheets may be calipered.

A variation of 0.003 in. on either side of a 20 gauge (0.0375) in. thick sheet still leaves it a good delivery, yet that represents 8 per cent of the thickness of the sheet as ordered and 8 per cent of its weight. Therefore, we can easily see that individual sheets, if rolled to decimal thickness, may be much heavier or lighter than the average of a lot of sheets rolled to weight.

Several of the factors influencing the weight in thickness of a sheet are just as liable to bring it on the light as on the heavy side of the gauge. As a result, the average weight and thickness of all sheets should be somewhat less than that ordered plus a reasonable variation, although the chances are that it will come somewhere on the plus rather than on the minus side.





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